SCIENTIFIC AMERICAN

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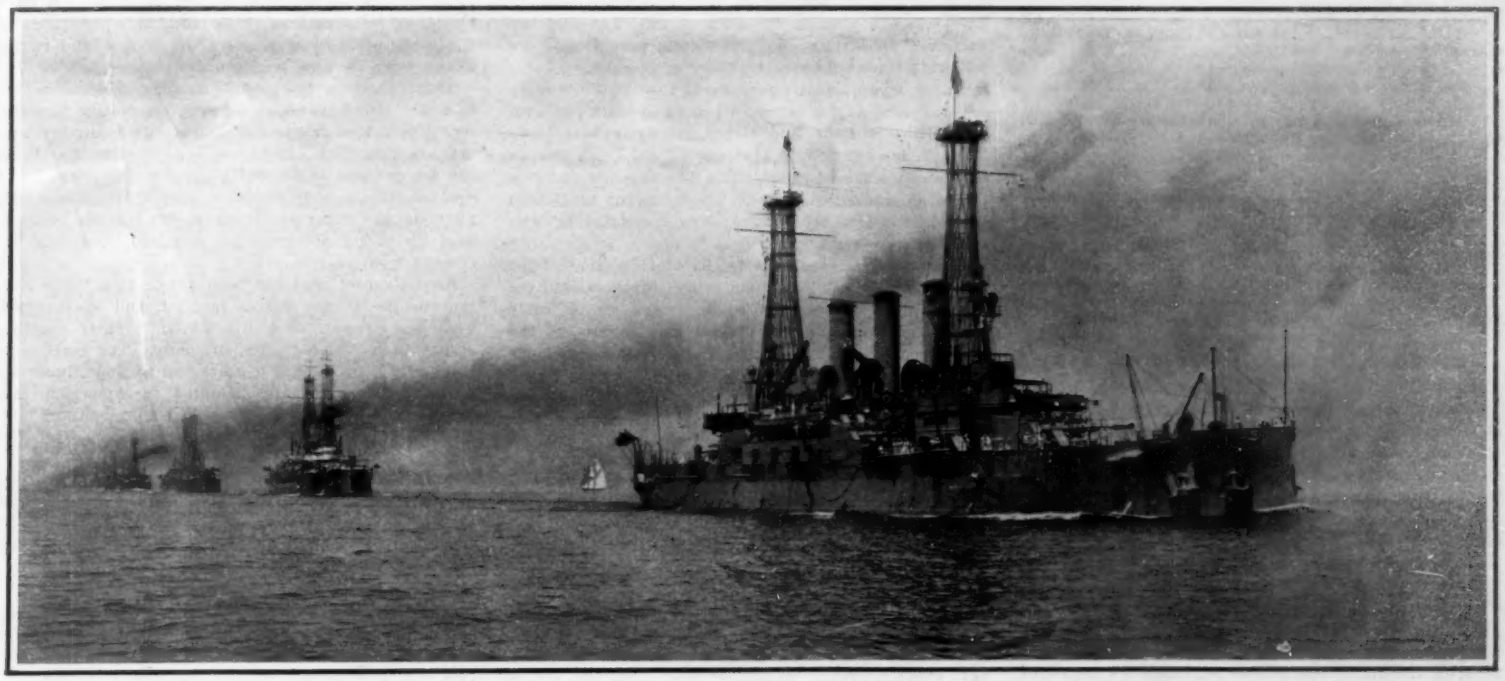
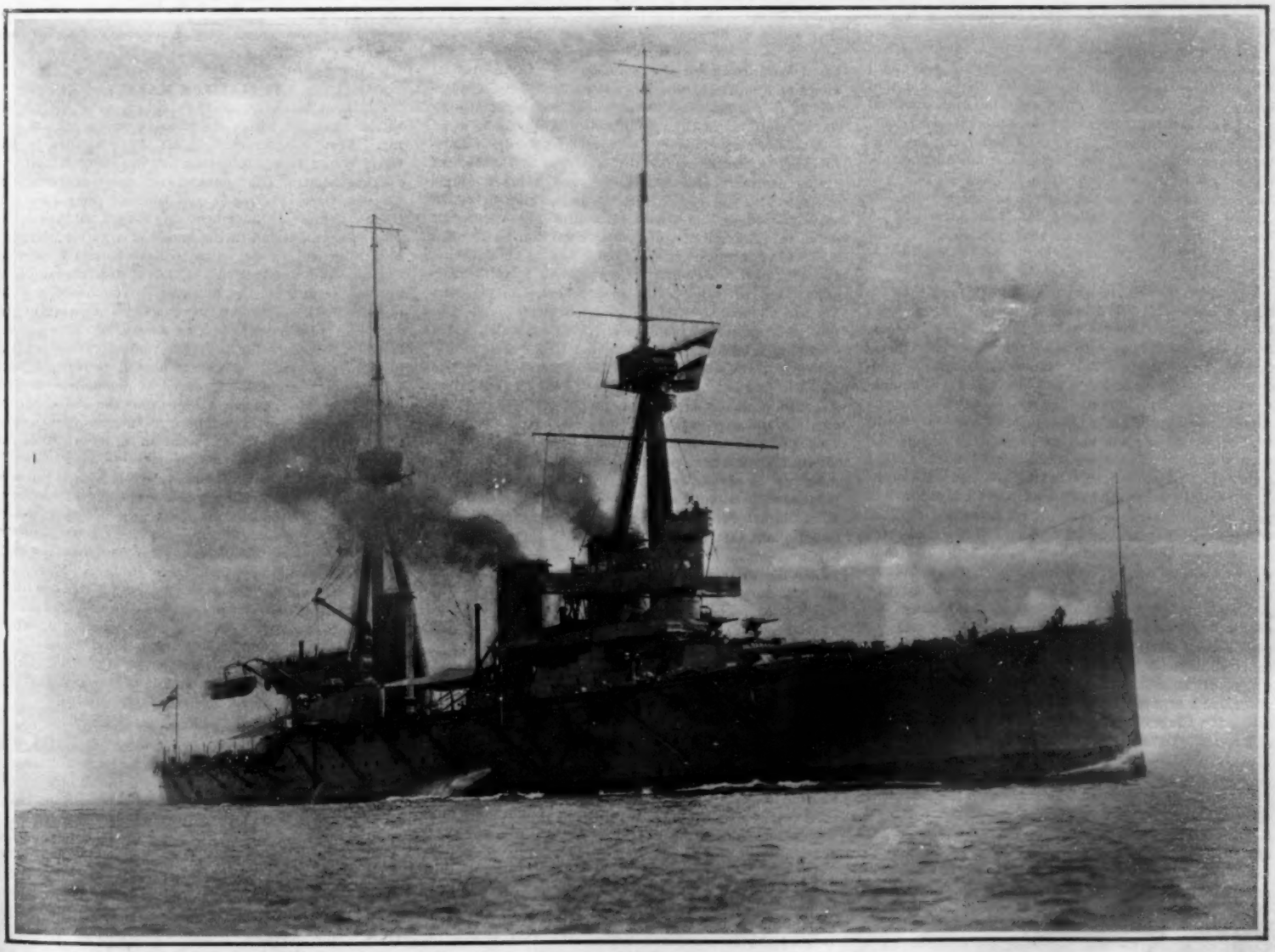


Copyright 1909 by E. Müller. **Displacement,** 16,000 tons. **Speed,** 18.8 knots. **Guns:** Four 12-inch; eight 8-inch; twelve 7-inch.

FLAGSHIP "CONNECTICUT" LEADING THE ATLANTIC FLEET INTO NEW YORK HARBOR FOR THE HUDSON-FULTON CELEBRATION.



Displacement, 17,250 tons. **Speed,** 28 knots. **Guns:** Eight 12-inch.

"DREADNOUGHT" CRUISER "INFLEXIBLE;" FLAGSHIP OF THE BRITISH SQUADRON AT THE HUDSON-FULTON CELEBRATION.—[See page 261.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, OCTOBER 9th, 1909.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PHILADELPHIA, THE DELAWARE RIVER, AND JOHN FITCH.

The widespread interest in the early history of the steamboat, which has been aroused by the present splendid tribute to the work of Robert Fulton on the Hudson River, has served to bring into public notice several too-long-neglected inventors, prominent among whom is John Fitch. With the exception of a small craft which he tried on the old Collect Pond in this city, the whole of the experimental work of this worthy man was done in Philadelphia and on the Delaware River.

We are free to confess that although we have always associated the name of Fitch with the development of the steamboat, it was not until we began to make a more thorough search of the history of the early inventors that we realized how important a part John Fitch had played in that period; how meritorious was his work; and how practical the degree of success which he attained.

It has been freely admitted that the present festival commemorates merely the inauguration of successful steamboat navigation on the Hudson River, and that the question as to who produced the first practical passenger-carrying steamboat is still an open one. Therefore we suggest, in view of the fact that during three months of the summer and autumn of the year 1790, John Fitch was operating a passenger-carrying steamboat on the Delaware, which sailed according to a fixed schedule, and was advertised in the daily papers of that day, that it is incumbent on the city of Philadelphia to do justice to the memory of its too-long-neglected citizen.

The story of his life and his heroic struggle to design a successful steamboat, as written by his own hand, reposes at present in the Philadelphia Library, to whose care it was committed by Fitch shortly before his tragic death. This unique autobiography consists of five old ciphering books, dog-eared and thumb-worn, whose five hundred pages, covered with the characteristic writing of the author, contain several drawings, showing the various steps by which he developed the jet condenser, which played so important a part in driving his successful passenger steamboat of 1790. Regarding the criticism that his method of propulsion by means of a set of reciprocating paddles, arranged in a frame at the stern of the boat, was cumbersome and awkward, we would point out that, before making use of vertical paddles, Fitch investigated the rotating paddle wheel, and rejected it on the ground that much of the power of the engine was uselessly expended because of the obliquity of the paddles in entering and leaving the water, the water being alternately forced down and thrown up, with a proportionate loss of propulsive efficiency. On the other hand, argues Fitch, paddles can be made to enter and leave the water in an approximately vertical position, and practically the whole of the power can be used to good effect. Now, in this Fitch showed his engineering good sense; and it was not until over half a century later that the feathering paddle wheel was introduced. In this type, the floats are hinged at the outer ends of radial arms from a shaft, and by means of an eccentric to which each float is also attached, they are made to enter and leave the water in an approximately perpendicular position, a condition which John Fitch secured by his clumsy but effective reciprocating paddle arrangement. That it was efficient is shown by the fact that he attained on a measured mile, as testified to by several witnesses of high standing in the community, a speed of eight miles an hour, and that he ran his boat regularly between Philadelphia, Trenton, and way points at an average speed of seven miles an hour. This, be it remembered, was from two to three miles better than the best speed of the "Clermont" some twenty years later.

The ultimate failure of John Fitch was due to a lack of influential backing and to a combination of unfortunate accidents. During the winter following his successful season of 1790 he was engaged in the construction of a larger and more powerful vessel called the "Perseverance," which, unfortunately, was torn adrift and wrecked during a heavy storm on the Delaware River. Fitch understood full well the value and significance of his work, and he also realized that if he failed, it was not because of any inherent fallacies in his plans, but merely for lack of influence and the necessary financial support. Pitifully prophetic is the following sentence from the diary of this disappointed inventor, who evidently foresaw at that time his early death: "The day will come when some more powerful man will get fame and riches from my invention; but nobody will believe that poor John Fitch can do anything worthy of attention." The remains of Fitch lie in an unmarked grave. The scene of his labors is to-day barren of monument or memorial to bear tribute to his remarkable work.

We commend these facts to the consideration of the citizens of Philadelphia and those towns along the Delaware River which were the scene of his early labors and triumphant but short-lived success, in the hope that they may see their way to honor the memory and perpetuate the work of Fitch by some such services and permanent memorials as have marked the present Hudson-Fulton Celebration.

PALESTINE AND SYRIA THE ORIGINAL CEREAL COUNTRIES.

The origin of the cultivation of cereals has seemed lost in the night of time. At the beginning of the historical period, the culture of wheat had extended throughout the ancient world. It was practised in Egypt 4,000 years before the Christian era, and wheat is one of the five plants included in the annual sowing ceremony which the Chinese Emperor Chin-nung instituted 2,900 years before that era. Wheat and barley have also been found, in considerable quantities, in the palafittes or lake dwellings erected on piles in prehistoric times.

Ten years ago the problem of the origin of cereal culture was deemed insoluble, for botanists thought that wheat would never be found growing wild in any part of the world. Subsequently, however, much light has been thrown on the question by the theoretical views of Koernicke, who has reorganized the classification of cultivated varieties of wheat, and especially by the diligent historical researches of Aaronsohn.

Among the specimens of wild barley (*Hordeum spontaneum*) collected in 1855 by Kotschy, at the foot of Mount Hermon, near Damascus, was found a single example of a different grain, the importance of which was ignored at the time. Koernicke observed this plant in 1873, but devoted little attention to it until 1889, when he described it under the name *Triticum vulgare; var. dicoccoides*. He regarded it as the parent of our cultivated varieties of wheat, and his opinion was adopted by Ascherson and Schweinfurth. But this theory was founded on a single plant, which might well have been a plant of cultivated wheat accidentally mixed with the wild barley, for two other botanists had failed to find additional specimens in the same locality. Aaronsohn was equally unsuccessful in 1904, when he went to Mount Hermon in quest of the plant, but in 1906 he found the *Triticum dicoccoides* growing abundantly and in a great variety of forms on Mount Hermon, up to an altitude of 6,000 feet, and at other points in Syria and Palestine. It should be noted that wheat is not cultivated in either of these countries.

The plant is always found associated with wild barley, and grains of wheat and barley have always been found together in lake dwellings and Egyptian ruins, so that our ancestors appear to have cultivated the mixture of barley and wheat with which nature provided them. The Arabs have only one name for the two wild grains.

In 1907 Aaronsohn found a few rye plants in Syria. It is generally supposed that rye is a native of Europe and is, and always has been, unknown in the Orient. In 1908 Aaronsohn found wild barley in the valley of the Dead Sea, and wild wheat (*Triticum dicoccoides*) associated with wild barley on the slopes of Mount Moab and Mount Galaad, in the valley of the Jordan, and on the plateau of Es Salt, always growing in thin soil, parched by the sun, in crevices of limestone and basalt rocks.

HOME-GROWN SUGAR-BEET SEED.

As a result of an experiment which has been conducted near Phoenix, Arizona, it has been found that sugar-beet seed can be grown successfully in that section of the country, and better still, that it can be grown in a single year. In Arizona it is customary to plant sugar-beet seed the latter part of November, harvesting the crop the following July. It has been found that if the seed is planted a month earlier in the fall the beets will produce a crop of seed the following year. This takes sugar beets, for that section of the country, out of the biennial class, and puts them in with the winter annuals. It means the saving of a year in the production of seed, and will greatly simplify the process.

Nearly seven million pounds of sugar-beet seed are used in the United States every year. At present the bulk of this supply comes from Germany, and costs the American grower about ten cents a pound. The German method of producing sugar-beet seed is rather complicated. When the beets are dug in the fall a number of the best specimens, averaging in size from 20 to 24 ounces, are selected for "mothers." A sample taken from each of these mothers is analyzed for sugar content. In some cases the density and purity of the juice are also determined.

These mothers are divided into grades, according to sugar content, and stored in silos during the winter. Those that fail to come up to the required standard are discarded. In the spring these mother beets are set out and cultivated carefully. From them the seed of commerce is produced. By these painstaking methods the sugar-producing ability of the beets is kept up to its present high standard, and even increased from year to year.

Recently beet seed has been grown to a limited extent in the United States in Utah and Washington. This home-grown seed has shown greater yielding ability than the seed from Germany. The beets from home-grown seed have better quality and higher vitality, and seem better adapted to American conditions. Owing to the difficulty of production, however, beet-seed growing in Washington and Utah has not spread very rapidly.

With more favorable climatic conditions prevailing in Arizona, especially the absence of severe winter weather and the dryness at harvest time, it may be possible to make beet-seed growing an important industry there. Of course, since the beets are not dug in the fall, they cannot be selected as carefully as is done in Germany. Whether the quality of the product can be kept up by other methods of selection remains to be proven. Perhaps some method of breeding like that which is giving such good results in the corn fields of the Mississippi Valley may be adapted to sugar beets. The United States Department of Agriculture has been asked to investigate the matter. The results of this investigation will be awaited with much interest by the people of the sugar-beet-growing districts.

THE PLATINUM MARKET.

Platinum is likely to be raised in price, according to the measures which the Russian producers are taking. About 95 per cent of all the platinum in the world comes from the mines at Nijni Taguil and the neighborhood. The mines are now operated by English, German, French, and Russian companies, but there is now a movement in Russia to keep the platinum production in the hands of a native company or a State enterprise, so as to have Russia benefit by the platinum production instead of foreigners. Last spring the aide of the minister of commerce and industry, M. D. Konovaloff, presided at a meeting of the platinum producers, and the assembly came to the following decision in principle, namely, that all the platinum extracted in Russia should be turned over to a State establishment, which would deliver it to a commission charged with the sale of the same, and to be composed of seven members, a delegate of the lesser manufacturers, one from the mean and four from the leading producers who handle more than 800 pounds annually, also a government delegate. This commission will make a reckoning before the end of the fiscal year, and will publish the least price established for the following year. For the first year the price will be 21,000 roubles the pound ($710 per pound) for 83 per cent platinum. Upon the products which are turned over to the State establishments there will be allowed an advance of 80 per cent of the value, at a 5 per cent interest. It will be forbidden to export crude platinum, and the refining must be done in Russia. This decision is not as yet legalized, but it may be done in the future, and it is expected that the price of platinum will be accordingly raised.

A report on the resistance of rivets is presented by M. Ch. Fremont to the Bulletin de la Société d'Encouragement. It is pointed out that the resistance of riveted plates to statical forces or shocks should be borne as much as possible by the adhesion of the plates, and as little as possible by shearing of the rivets themselves, and the author emphasizes the necessity of standardizing the heads of rivets and of regulating the maximum temperature during the process of heating, so as not to destroy the elastic qualities of the rivet. The increased efficiency obtained by the application of continued pressure during the riveting is also mentioned.

ENGINEERING.

The Baku-Batoum petroleum pipe line has had to be renewed for some 50 miles, between Adschikabul and Jelissawetpol, where it passes through salt-carrying districts. The corrosion there is more rapid than over the rest of the route, so that excessive leakage has been caused.

Visitors to Admiral Seymour's flagship, the "Inflexible," which is the only vessel of the "Dreadnought" type at the Hudson-Fulton Celebration, will be interested to learn that the new "Dreadnought" cruisers, according to the British press, are to be much larger and more powerful. They will have a length of 600 feet as against 560 feet, a total horse-power of 60,000 as against 50,000, and twelve 12-inch guns in place of the eight 12-inch carried by the "Inflexible."

There is a certain amount of sentimental interest attaching to the fate of a transatlantic record breaker, and it is therefore gratifying to learn that the Cunard Company have arranged to accept $500,000 in settlement of the insurance on the recently burned "Lucania," and reconstruct this famous boat, making her thoroughly up to date in the matter of accommodations, etc. The "Lucania" was the first vessel to cross the Atlantic at an average speed of 22 knots.

It is gratifying to note that the large sea-going torpedo boats which are being built for the navy are making, on trial, speeds which are greatly in excess of the contract requirement. The "Flusser," built by the Bath Iron Works, recently made between 32 and 33 knots on trial, and now a sister vessel, the "Smith," built by William Cramp & Sons, has made 32 knots on trial. Because of their large displacement of 700 tons, these high speeds on trial mean much more than the high speeds achieved with our earlier boats, which have never approached in average day by day service the record made on their trial trips.

At the naval depot at Horton, Norway, the Norwegian government is refitting Nansen's old Arctic vessel, the "Fram," for another trip to the Arctic. A new gasoline engine capable of driving the vessel at four or five miles an hour is being installed, and a thorough overhaul is taking place. In a recent letter to the Norwegian consul at San Francisco, Capt. Amundsen states that he expects to leave San Francisco next June for the Behring Sea, where he will allow his vessel to be frozen into the ice and be carried by way of the Pole toward the northern part of Greenland. The "Fram" is about three times the size of the "Gjoa," now in the Golden Gate Park, San Francisco, in which Amundsen recently made his famous northwest passage.

Notice was recently given to the Treasury Department at Washington by the Pennsylvania Railroad Company that it proposes to operate its trains into the new station on the first day of December. In the great terminal between Seventh and Eighth Avenues and 31st and 33rd Streets there are sixteen miles of track, including twenty-one standing stations. Two tunnels connect the station with New Jersey, and four with Long Island. Started in 1902, work has been carried on continuously ever since, and when the scheme is fully completed it will have cost over $90,000,000.

It will be remembered that at the opening of the Alaska-Yukon Exposition at Seattle, the Great Northern Railway put on a 60-hour train from Chicago to Puget Sound. With the completion of the new Milwaukee, Chicago & St. Paul extension, the Maintenance of Way Department will bend their efforts to bringing the new track into such high-class condition as to permit of the running of high-speed through expresses from Chicago to the coast. The Milwaukee managers expect that next spring they will be in a position to offer a 54-hour schedule from Chicago to Seattle. This, coupled with the 18-hour service from New York to Chicago, will bring the time between New York and the coast down to three days.

The greatest possible interest attaches to the announcement that Mr. George Westinghouse, Rear Admiral Melville, and Mr. John MacAlpine have devised and built a reduction gear for interpolation between the steam turbine shaft and the propeller shaft for turbine-driven marine engines. The necessity for reducing the economical speed of the turbine to the economical speed of the propeller has long been manifest, and as we stated editorially last week, considerable effort has been directed to this problem. The helical spur gear has been in use for many years on the De Laval turbines, but in the present device, by an ingenious construction of an automatically adjustable bearing, it has become possible to apply this gear so as to transmit 6,000 horse-power, at 1,500 revolutions of the pinion per minute, at a reduction ratio of 5 to 1. It is claimed by Mr. Westinghouse that using this reduction gear, and with an inconsiderable loss from friction, it would be possible to apply the 70,000 horse-power of the "Mauretania" to three propellers with a reduction of 50 per cent both in the weight of the turbine and in the length of the engine room.

AERONAUTICS.

Orville Wright, on September 30th, made another record for height while flying before the Empress of Germany and other members of the royal family at Potsdam. On this occasion, according to cable reports, he reached a height of 275 meters (902 feet). This is over 50 feet higher than his previous record made only a week before.

In connection with Berlin's aviation week, Hubert Latham made some excellent and startling flights recently. On the 25th ultimo he made a 20-minute flight above Tempelhofer field. The flight was terminated because of heavy rain. Two days later he made the most daring flight up to date, when in 24 minutes he flew from Tempelhofer field across Berlin to Johannisthal, where the aviation meeting was being conducted. The flight was made at a height of about 300 feet, the distance of 11¼ miles plus two circuits of the field (3.1 miles) upon his arrival being covered in 24 minutes.

Besides the exhibition of Curtiss's 60-horse-power biplane in Wanamaker's store in New York last week, another of these machines fitted with a 30-horse-power 4-cylinder motor was exhibited at the aeronautic show in Madison Square Garden. There were also two other similar biplanes, but one of which was fitted with a motor, however, and had made a short flight. The Braunier & Smith biplane resembled both the Wright and the Curtiss. It had the twin vertical rudders of the former and the single-surface horizontal rudder of the latter. C. & A. Witterman exhibited a strong, well-built biplane glider that attracted considerable attention. Several other gliders were shown, as well as numerous models, samples of balloon and aeroplane cloth, aeroplane parts, etc.

On October 1st, at the Berlin aviation meeting, Rougier, with a Voisin biplane, made an excellent endurance flight in which he remained aloft 2 hours, 41 minutes and 50 seconds. Making 52 circuits of the field, he covered an official measured distance of 130 kilometers (80¾ miles) at an average speed of 30 miles an hour. Probably he actually covered over 90 miles in view of the many turns. The flight was only terminated because of approaching darkness. While Rougier's official record does not beat Farman's, it is encouraging as showing that a gasoline motor can be made to run for a long time on an aeroplane as well as on an automobile. The same day Farman flew 1 hour and 32 minutes, covering 82½ kilometers (51.23 miles) at an average speed of 33.41 miles an hour. Baron de Caters flew 18.6 miles in 34 minutes.

Just after we had gone to press with our last issue, which contained an article upon aeronautic accidents, the worst disaster of modern times occurred in France. Owing to the breaking of a propeller blade (which was projected clear through the balloon envelope) the new military dirigible "République" was almost instantly deflated, causing it to fall to the ground from a height of 500 feet. The four officers who formed the crew were all killed almost instantly. This disaster gives a strong argument in favor of the rigid-frame, compartment dirigible of Count Zeppelin, which, it will be remembered, successfully went through a similiar accident a few weeks ago. In this connection it is interesting to note that Wilbur R. Kimball had on exhibition at the preliminary aeronautic show last week in Madison Square Garden, New York, a model of a non-rigid dirigible which had a ring of small propellers completely surrounding it. He argues that small light wood propellers can be run at high speed without danger of breakage, while a greater thrust per horse-power is also attainable.

Owing to rainy and windy weather, the aeroplane flights of Wilbur Wright and Glenn Curtiss from Governor's Island up the Hudson River to Grant's Tomb and back did not take place last week as scheduled. Up to Saturday noon the only flights that had been made were a short half-mile jump by Curtiss shortly after 7 A. M. last Wednesday, and three practice flights by Wilbur Wright the same day. Two of these were made at 8:56 and 10:16 A. M., and were of 5 minutes 27 seconds and 6 minutes 33 seconds duration respectively. They were made in a strong westerly wind of about 20 miles an hour velocity. The first one consisted of the circling several times of the island, the machine flying most of the time at a height of 50 feet above the water. The second flight was much more sensational, for after circling Governor's Island as before, Mr. Wright flew over to Bedloe's Island and around Bartholdi's famous Statue of Liberty. After making all his great records in France, it was particularly fitting that Wilbur Wright, in his first great public flight in America, should pay a visit to France's gift to her sister republic. These two flights, as well as the third one of 2 minutes 41 seconds duration, which was made at 5:25 P. M. in what was, if anything, an even stronger breeze, gave an excellent demonstration of Wright's ability to fly in a strong wind. It is probable that as soon as a reasonably calm day occurs he will make a record flight that will remain unbeaten for some time.

SCIENCE.

The United States Department of Agriculture is investigating the various methods of preserving eggs, for the purpose of determining which method is most efficacious and works least injury to the eggs. It has been discovered that the amount of moisture in the air surrounding the egg is an important factor in egg preservation, for which reason the Department is conducting experiments to devise a means for regulating the amount of air supplied to eggs kept in cold storage.

Col. Kozloff's Mongolian expedition, equipped by the Russian Geographical Society, has returned after twenty months of exploration in the region of the Andos Mountain range in Tibet. The chief discovery made was of the ancient city of Kharakhoto, called by the Chinese Siansin, which the Manchurians destroyed more than 500 years ago. The explorers found a great quantity of relics used in Buddha worship, a metal figure of Buddha perfectly preserved, and perfectly preserved manuscripts on canvas and silk in the Chinese, Manchurian, and Tibetan languages.

F. Fritz has discovered that the domestic cat possesses a peculiar organ of sense, consisting of a few long and stiff bristles, or feelers, which spring from a region of the skin richly furnished with nerves in the vicinity of the wrist joint of the fore leg. These organs, called "carpal vibrisse," had previously been found in numerous animals, including rodents, edentata, carnivora, the lower quadrumana, and *Hyrax*. They are found chiefly in animals which hold their food with their forepaws, or which crawl and climb. Thus, they are wanting in the ungulata, with the exception of *Hyrax*, and also in the apes and monkeys, which possess, in their fingers and palms, much more delicate tactile and prehensile organs. It is remarkable that they are also wanting in the dog, in which animal Fritz has sought them in vain.

The Academie des Sciences recently awarded a number of prizes for scientific work. In mechanics, M. Lecornu, professor at the Polytechnic College, received the Montyon prize, $140; M. de Sparre the Poncelet prize, $400; M. Boulanger the Boileau prize of $260. In astronomy, the Lalande prize of $108 was awarded to M. Borelly, of Marseilles. For navigation the grand prize of the marine, $1,200, was divided among Messrs. Colin, Jeance, Marbec, Doyère, Lecocq, Tissot, and Fromaget. The Plumey prize of $800 was awarded to Messrs. Routier and Caralp. In mineralogy and geology, the Raulin prize of $30 was given to M. Leon Bertrand, and the Labbé prize of $200 to G. Rolland. Prof. Mercadier of the Polytechnic College received the Pierson-Perrin prize of $10,000. The Delesse geological prize of $280 was awarded to Prof. Glangeaud, of Clermont. In medicine, a number of prizes were awarded, among which was the sum of $800 given by the academy itself to Dr. Haffkine for his work on vaccination for cholera and bubonic pest. The academy also distributed the second annuity of $5,000 coming from the Bonaparte fund among different workers in the scientific field.

A letter has been received at Harvard College Observatory from Prof. G. C. Comstock, Director of the Washburn Observatory, giving the following "finding ephemeris of Halley's comet," derived by him:

"Perihelion Passage, April 18th."

Paris M. T. 1909.	D.	R. A. H.	R. A. M.	Dec. Deg.	Dec. M.	Mag.
September	22.5	6	19.3	+17	7	15.1
"	27.5	6	18.8	17	5	
October	2.5	6	17.8	17	3	14.8
"	7.5	6	16.0	17	1	
"	12.5	6	13.4	16	59	14.5
"	17.5	6	9.8	16	58	
"	22.5	6	4.9	16	56	14.1
"	27.5	5	58.9	16	54	
November	1.5	5	51.3	16	52	13.8
"	6.5	5	42.1	16	50	
"	11.5	5	30.8	+16	47	13.4

"The above ephemeris is derived from that of Holetschek, Astro. Nach. 4330, by interpolating the time of perihelion passage so as to satisfy observations made by Burnham and Barnard, September 15th and September 17th respectively."

A letter has been received at this observatory from Prof. E. B. Frost, director of the Yerkes Observatory, stating that Halley's comet was observed visually by Prof. E. E. Barnard on September 24 d. 20 h. 22 m. 21 s. G. M. T. in

App. R. A. 6 h. 18 m. 56.72 s.

App. Dec. + 17 deg. 6 m. 11.2 s.

Comet followed comp. star 0 m. 19.03 s. by 8 direct measures.

Comet north of comp. star 0 m. 39.4 s. by 9 direct measures.

The comparison star was Berlin A. G. 2122.

"The comet was considerably brighter than on the 17th; estimated as 15th mag; measured diameter 11 s.; indefinite condensation almost amounting to a small nucleus; no definite boundary."

STEREOSCOPIC MOVING PICTURES IN NATURAL COLORS.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

During the past few months several devices have been perfected for producing moving pictures in their natural tints, all carried out upon the same lines. All suffer from the same disadvantage—the color rendition upon the white screen is imperfect and untrue. Mr. William Friese-Greene, F. R. A. S., F. R. M. S., exhibited in London as far back as 1898 a series of animated natural-color pictures. The system, which he duly patented, was to revolve a disk of glass divided into three equal sized sectors, each representing one of the three fundamental colors, and revolving it in front of the lens as the exposures were being made, each section of the sensitized film (corresponding with the size of the ordinary cinematographic picture) being exposed through one of the three color filters. In making the subsequent projection the colored disk was again revolved in such a manner that the same relationship of picture to color filter that prevailed during the exposure of the negative was repeated. The rays of light consequently passed through the black-and-white film and thence through the color filter. The resultant picture was projected in accordance with the well-known phenomenon of visual persistence, producing the impression of a complete three-color image.

The demonstration aroused considerable interest, but the inventor soon realized that such a system possessed one serious disadvantage. The glass disk had necessarily to be of a certain thickness—from one-sixteenth to one-twelfth of an inch—so that there was a certain depth of transparent glass through which the light rays had to pass before or after reaching the color filter, depending on whether the color side of the disk was next to the transparent film or reverse. This fact produced disturbances in light refraction and reflection, of such a severe character that the projected image as seen upon the white sheet was a color distortion and a crude reproduction of nature. The extent of the deflection of the light rays in passing through the transparent thickness of the glass disk varied considerably, and in the resultant picture occurred an undue predominance of one or two colors, which completely destroyed the natural effect. It is this system which is now being developed by various experiments in the field of chromo-photography, but which the original inventor abandoned for the foregoing reasons.

By continuing his experiments Mr. Friese-Greene was enabled to overcome all the incidental difficulties inherent in his first apparatus. He abandoned the revolving glass disk and resorted to a prism placed in front of the lens. This yielded a much more satisfactory result but was naturally somewhat primitive and commercially impracticable. Recently, however, he has completed and patented an entirely new system, which, together with many other important improvements he has effected in connection with the apparatus itself (both camera and projector) and also in the preparation of the sensitized films, promises to improve chromo-photography.

Through the courtesy of the inventor the writer was afforded an opportunity of examining the apparatus, and the whole process of taking and projecting films by this new system, for the SCIENTIFIC AMERICAN, while the accompanying illustrations, specially taken for these pages, serve to show the camera and its method of operation. At the time of writing some twenty films had been secured, depicting varying scenes in natural life from incidents in busy streets to studies of insects and growing flowers. Not only are the color effects obtained, but they are stereoscopically projected. The effect produced upon the screen is precisely the same as that obtained with ordinary stereoscopic photographs when observed through the hand instrument devised by Oliver Wendell Holmes.

With this apparatus, moreover, a continuous picture is obtained, which is not the case in the ordinary machine. In the latter instance, as is well known, the

(*Continued on page 269.*)

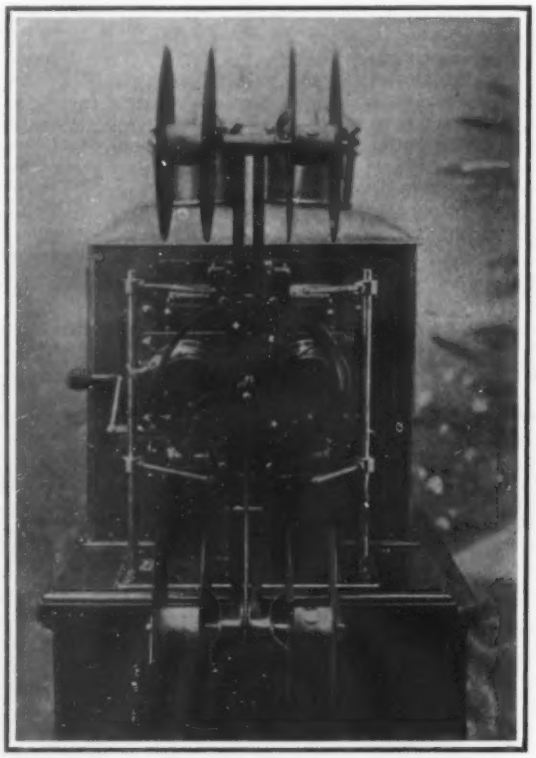


Fig. 4.—Front view of stereo-chromo-cinematograph projector, showing how the twin lenses are alternately exposed by the shutter.

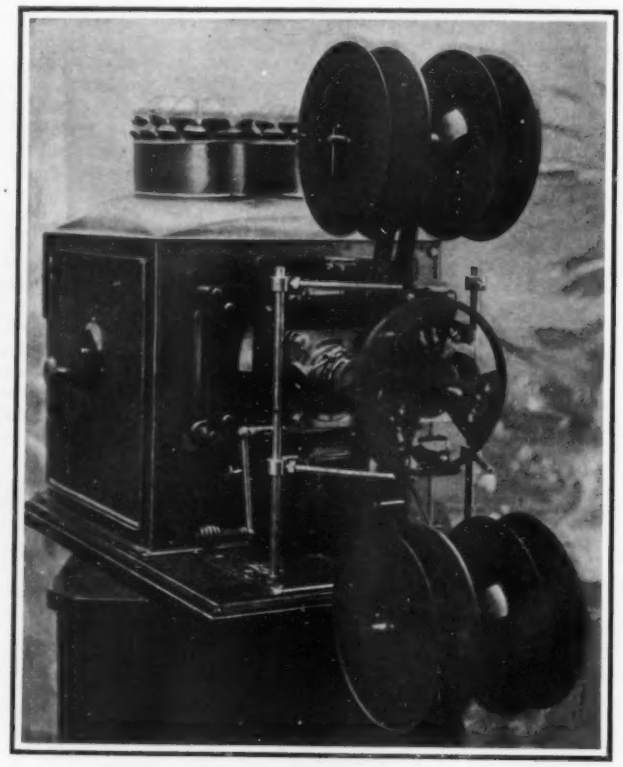
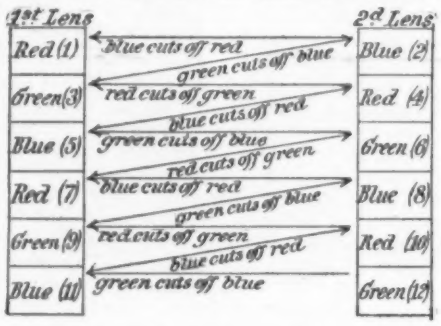


Fig. 5.—A three-quarter view of the stereo-chromo-cinematograph, showing the mechanism for carrying the endless color band.

DIAGRAM SHOWING METHOD OF WORKING COLOR FILMS OF TWO LENSES ALTERNATELY IN FRIESE-GREENE'S CHROMO-CINEMATOGRAPH.



Red (1) in first lens is exposed followed by Blue (2) second lens
Green (3) " " " " " " " Red (4) " "
Blue (5) " " " " " " " Green (6) " "
Red (7) " " " " " " " Blue (8) " "
Green (9) " " " " " " " Red (10) " "
Blue (11) " " " " " " " Green (12) " "

Fig. 1.—The face of the camera with lenses removed.

The shutter exposes one lens while the other is closed to bring a fresh section of film and its relative color filter before the lens aperture. In the aperture shown open, the blue filter may be seen.

Fig. 3.—Interior of one side of the camera.

Showing system and mechanism for operating the endless band of color filters and how it is brought into juxtaposition with the sensitized film before exposure and separated therefrom after exposure.

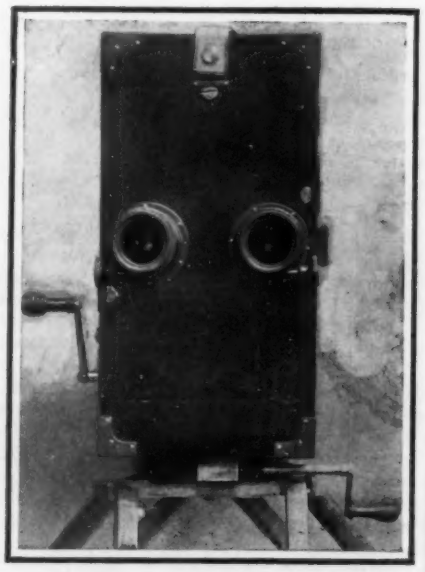


Fig. 2.—Face of the machine, showing twin lenses for securing stereoscopic effects.

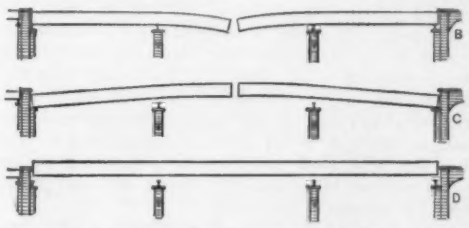
The handle at the left drives the photographing mechanism, while on the right the sighting device is shown closed.

STEREOSCOPIC MOVING PICTURES IN NATURAL COLORS.

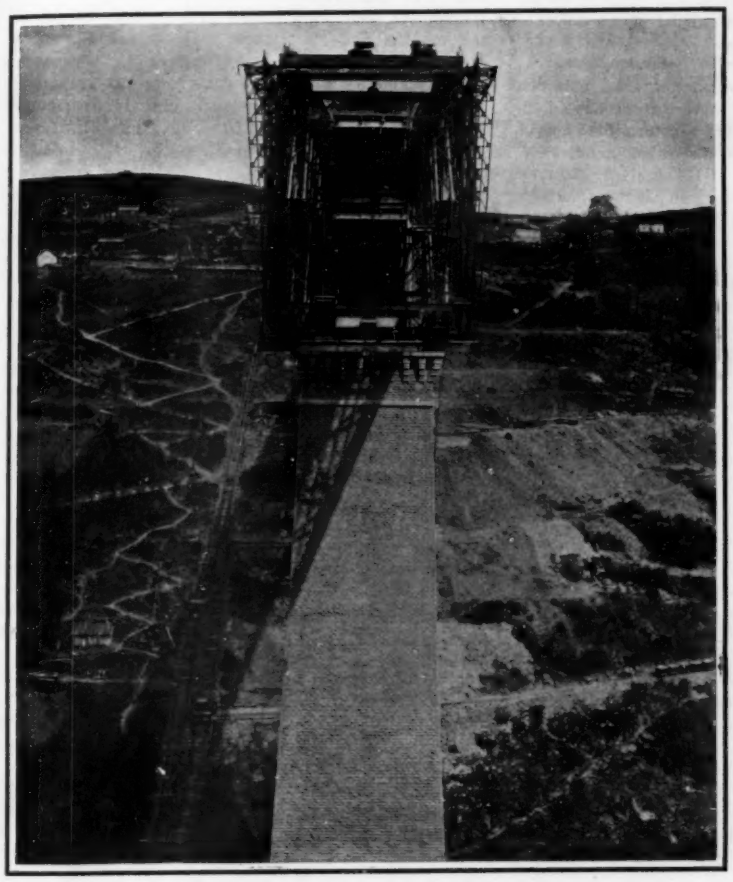
ERECTION OF THE FADES VIADUCT.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

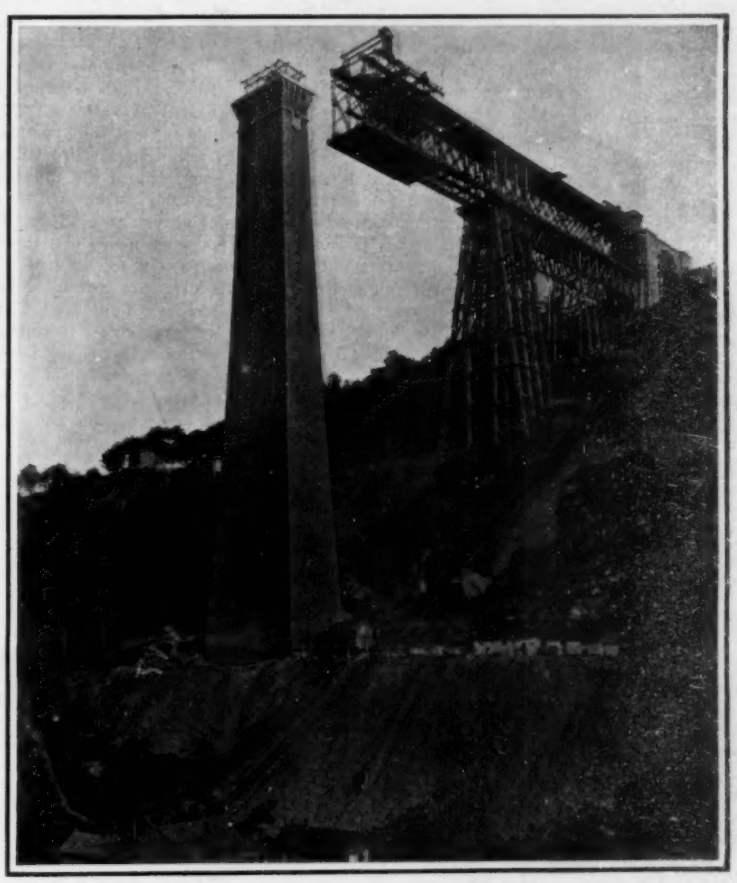
A piece of bridge construction work presenting some noteworthy features has recently been carried out in France. It is known as the Fades Viaduct, and is designed to take the railroad across the wide valley in which flows the river Sioule. The present work is notable for two reasons, one of these being the exceptional height of the masonry pillars, which are built in the valley, and in the second place for the considerable length of the central span. The viaduct has the form of a straight iron lattice-work bridge construction. It is carried upon two lofty piers and two abutments, the length of the consecutive spans being 383 feet, 475 feet, and 383 feet. The flooring of the viaduct lies at a height of nearly 440 feet above the level of the Sioule. The height of the great masonry columns of rectangular section is 304 feet, and they appear to be the highest pillars for a bridge built in Europe up to the present. The whole undertaking reflects great credit upon the constructors, the well-known Cail Company, and the work was carried on under the general direction of its chief, M. Le Chatelier, from whom we have obtained the following points: The most difficult part of the work was to make the junction between the overhanging halves of the central span. This was carried out on the 18th of May last and the operation was performed with remarkable precision. To make the junction, the whole bridge had to be lifted off the two main columns by hydraulic jacks, in order to make up for the slight sinking of the two fore ends and bring these exactly opposite each other and in true line. After joining the ends, the bridge was lowered again upon its supports. The present viaduct lies upon the railroad which runs in the southeastern part of France in the region of Clermont-Ferrand, and is built upon the section which runs between Saint-Eloy and Pauniat. On each side of the 475-foot central span there is a side span of 383 feet. In the rear of the stone abutments there is an approach to the main structure consisting of a small masonry arch of 46 feet span on one side, and at the other end is built a 162-foot truss span. The two main stone piers sup-



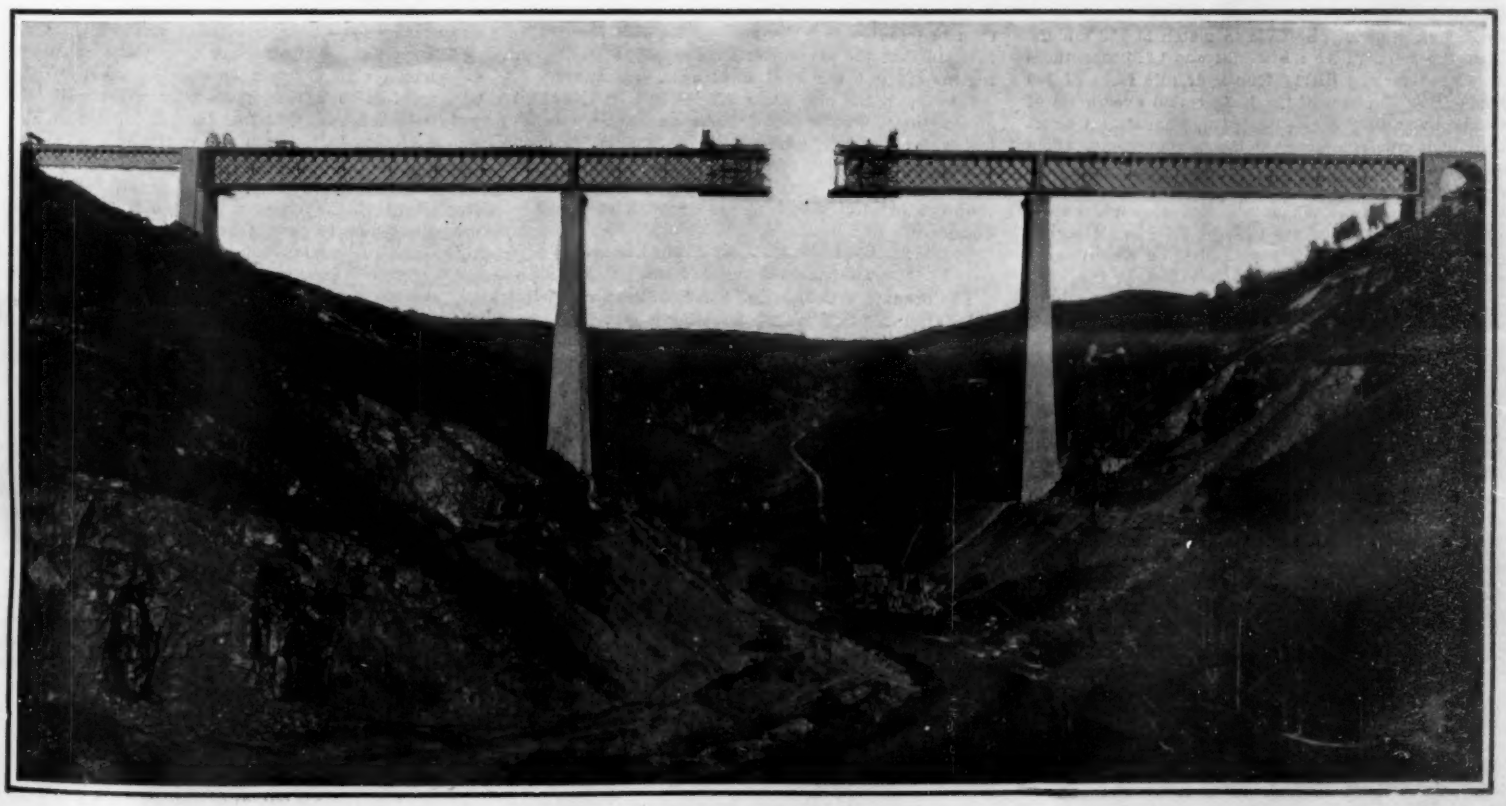
B. Ends overhanging. C. Lifting off the pillars and jacks and lowering at the buttresses. D. Lifting at the buttresses and joining ends.



End view of the truss.



Method of construction on end spans.



The meeting ends of the truss in the central span.

ERECTION OF THE FADES VIADUCT.

porting the central span of the viaduct are built to a height of 304 feet above their foundations. These latter are carried down to a depth of 40 feet for the pier lying on the left bank, which makes the total height of the stone work to be 344 feet. For the foundation on the other bank the depth is somewhat smaller, making the total height of the pillar to be 312 feet. The bridge is constructed for single track standard gage, and is built of a rectangular cross section consisting of two main side lattice trusses 38 feet deep, which are spaced 22 feet between centers. Upon the top are laid the floor beams which serve to support the stringers, and upon these rest the rails of the track. The sway bracing is spaced at intervals of 48 feet. In order to allow for expansion and contraction, the structure is fixed at one of the abutments only, while upon the two main pillars and the other abutment it is mounted upon a movable support of the usual kind.

In constructing the bridge, it was not found possible to use the method which consists in building the spans on the ground back of the site and then driving them forward into place, seeing that there was not the available space for carrying this out. Another method, therefore, had to be employed, and it consisted in the use of a scaffolding which is mounted under the side spans. The bridge was built from the abutments to the end of the scaffolding; and from this point it was built across on the overhanging principle until it reached the main piers, falsework being used below the first half of the span. One of the characteristic features of the work is the erecting of the bridge in the overhanging portions. In order to carry this out there was used a cage-like traveler, which ran along upon the outside and surrounding the truss. It traveled upon rails which were laid upon the top of the truss and upon the two sets of rollers. Measured from the flooring and from the back end of the cage, the first roller lies at 13 feet and the second at 40 feet distance, representing the end point of the truss, but the fore part of the cage projected out from the finished end of the truss with an overhang of 33 feet. On the inside of the truss there was a corresponding structure, built of timber. Upon it were three working platforms, arranged to give access to the different heights. Supported from the inner timber structure and also from the outer cage there were hanging platforms which were let down by pulleys, for the workmen who operated the compressed-air riveters. These latter were hung down at the level of the platforms by traveling carriages, which ran upon upper rails at the top of the cage. On the top was also mounted a large traveling erecting crane, designed to take the beams and other material from the back end and bring it forward to the working point. In this way the work advanced at the average rate of 3 feet per day. The trusses were thus brought forward to the main piers at each side. They were built forward in the same way to form the middle span. When the halves of the middle span met they deflected below the normal position, and it was necessary to lift them to their true level. The operation was carried out by raising the trusses off the piers by hydraulic jacks, and at the same time lowering them at the abutments, thus tilting up the spans as a whole and allowing the ends to match at the middle. Upon the piers, where the weight was 1,200 tons, there were used for the lifting four hydraulic jacks of 300 tons each. The base of the jacks rested upon a set of rollers, so as to give the needed movements. A small 5-ton hydraulic jack gave the lateral movements which were required. In this way the two trusses were raised and brought into exactly the proper position at the meeting point. When this was done the chords were joined, by temporary bolts at first, so as to complete the truss from end to end, making a continuous structure. The bridge was then raised at the abutments and finally lowered into place upon the pillars, so as to bring it to its normal position.

German-American Patent Treaty.

The American Association of Commerce and Trade in Berlin issues the following announcement, prepared by Henry Schmidt, on the effect of the new patent treaty between this country and Germany:

The new patent treaty between the United States and Germany, which went into effect on August 1, places American citizens on a decidedly better footing in regard to the utilization of patent protection in Germany, as it frees them from the obligation to work their patented inventions in Germany within three years from the granting of the German patent. Heretofore any failure to comply with this working obligation would, in the case of an action for revocation of the patent being brought against the patentee, result in the loss to him of his German patent.

This is no longer to be the case with the German patents of United States citizens, as the new treaty provides that the working of a patent in the territory of one of the contracting parties shall be considered as equivalent to its working in the territory of the other party. Hence, an American citizen who works his United States patent in the United States will no longer be required to work his corresponding German patent in Germany in order to avoid loss of his German patent in case of an action for revocation being brought against him.

The question as to whether the provisions of the treaty are to apply also to existing German patents in regard to which the three-year term allowed for working already expired before the date on which the treaty went into effect, is not decided yet; but many persons are of the opinion that even such patents will now be entitled to the benefits of the treaty, provided that no action for revocation was actually entered prior to that date. At any rate, it may be assumed that, in addition to all German patents applied for after that date, such older patents in regard to which the three-year term extends beyond that date will enjoy the benefits of the treaty.

This new treaty, abolishing, as it does, a condition of affairs that has been felt as a hardship by American inventors, will no doubt induce many American inventors to apply for German patents in cases in which they would otherwise have abstained from so doing.

Electricity and Vegetation in Polar Regions.

Electroculture is an old subject, upon which opinions are still at variance. Some investigators have definitely rejected the hypothesis that vegetation is affected by atmospheric electricity. On the other hand, Prof. Lemstroem, of the University of Helsingfors, Finland, vigorously sustains this theory and adduces experimental evidence in its support. Lemstroem asserts that when plants cultivated in the polar regions escape destruction by nocturnal frosts, they grow far more rapidly and luxuriantly than plants growing in milder climates. Rye, barley, and oats, especially, yield very large crops, in spite of primitive methods of cultivation with wooden plows and harrows. The growth of plants depends not only on the fertility of the soil, but also on the supply of heat, light, and moisture. In the polar regions the supply of heat is very small. The rapid growth of plants in these regions has hitherto been attributed to the continuous daylight of two or three months in summer, but this explanation must be abandoned, since it has been proved that, even in those months, less heat and light are received from the sun in the polar regions than at the latitude of 60 degrees. Lemstroem finds several reasons for believing that the cause of rapid growth in the Arctic is to be found in the electrical currents which flow between the earth and the atmosphere, and produce the phenomena of the aurora borealis. The pointed leaves of conifers and the barbs of ears of grain facilitate the transmission of these currents through those plants, and this function supplies a reason for the existence of these peculiarities.

From a study of the concentric annual layers of growth of conifers growing in various latitudes, between the 60th and 67th parallels, Lemstroem finds that the thickness of the annual layer varies according to a definite law, showing maxima and minima which indicate a period of ten or eleven years, coinciding with the period of sun spots and auroras. The differences, furthermore, are greater in the great firs within the Arctic circle, at 67 degrees north latitude, than in trees growing further south. This appears to indicate that the atmospheric electricity of the polar regions exerts a beneficial effect upon vegetation.

Lemstroem has also made experiments on the effect of electricity, produced by a Holtz machine, upon barley, wheat, and rye, growing in pots and in the open ground. The results of these experiments appear to him to give support to his theory of the favorable influence of electricity upon the growth of plants.—Cosmos.

The Current Supplement.

The opening article of the current Supplement, No. 1762, discusses in a most interesting manner the caisson method of sinking the Detroit River tunnel. Excellent illustrations accompany the article. "Platinizing or Platinum Plating" is the title of an article which gives some very interesting technological information. The comparison of the phonograph and photograph by Dr. R. Defregger in an article entitled "The Analytic Eye and the Synthetic Ear" illustrates the contrasts between the senses of sight and hearing. Our impression of the universe, as the article points out, would be curiously different if the functions of these two senses were interchanged, so that the ear would perform the work of analysis and the eye the work of synthesis. Thomas W. Rolph discusses the different practices of illumination. He points out that in the field of illumination practice is several thousand years old, while theory is only beginning to be developed. He gives also helpful suggestions as to proper illuminations for various types of interiors. A *résumé* of some recent processes for the fixation of atmospheric nitrogen is presented. L. Zehnder writes on the dangers of atmospheric electricity in aeronautics. A telephone system for Peking is described. G. Millochau of the Paris Observatory discusses the subject of stellar evolution and the origin of worlds. How water and milk may be sterilized with ultraviolet rays is pointed out by P. Santolyne. The great monumental structures of the later stone age were necessarily erected without the employment of any more elaborate machinery than levers and rollers from trunks of trees. A discussion of the wonderful monuments thus erected is presented. Dr. George M. Gould's paper on the rôle of visual function in animal and human evolution is published.

The Highest Balloon Ascension in America.

Although a large number of *ballons-sondes* were dispatched from St. Louis in 1904-7 under the direction of the writer, none had been employed in the eastern States until last year. In May and July, 1908, four *ballons-sondes* were launched from Pittsfield, Mass., with special precautions to limit the time they remained in the air and so prevent them from drifting out to sea with the upper westerly wind. Three of the registering instruments have been returned to the Blue Hill Observatory with good records. The first instrument sent up on May 7th was not found for ten months and the record, forming the subject of the present article, is very interesting because it gives complete temperature data from the ground up to 17,700 meters, or 11 miles. This is 650 meters higher than the highest ascension from St. Louis, which, by a coincidence, was also the first one to be made there. On May 7th a general storm prevailed, so that the balloon, traveling from the east, was soon lost in the cloud and its subsequent drift could not be followed, but the resultant course was 59 miles from the southwest, as determined by the place where the instrument fell two hours later. At the ground the temperature was 4.5 deg. C., and this decreased as the balloon rose to the base of the cloud, which itself was considerably warmer than the underlying air. Above the cloud the temperature continued to fall with increasing rapidity up to a height of 12,500 meters (nearly eight miles) where the minimum of —54.5 deg. C. was registered. Here the great warm stratum was entered and penetrated farther than ever before in this country, namely, to the height of 17,700 meters, where the temperature was —45.6 deg. C. An increase of 10 deg. occurred, however, in the first 3,000 meters, for above 15,500 meters nearly isothermal conditions prevailed, confirming the belief of Teisserenc de Bort that what he calls the "stratosphere" is composed of a lower inverting layer with isothermal conditions above extending to an unknown height. In an ascension last November in Belgium the relatively warm stratum was found to extend from 12,900 meters to the enormous height of 29,000 meters, or 18 miles, where there was still no indication of its diminution.—A. Lawrence Rotch in Science.

Glass Espalier Walls.

When vines and trees are trained in espaliers on the south side of a wall, the north face of the wall is usually wasted, although it can be used for the cultivation of varieties of apples, pears, and cherries which are hardy and not subject to rot. If a transparent wall could be used, plants growing on both sides of it would receive the benefit of the sun's rays. Some experiments have been made with glass walls. Count de Choiseul recently published the results of such an experiment, with photographs showing heavily fruited pear trees on both sides of the transparent wall. The wall, which is about 60 feet long and 6½ feet high, was erected in 1901. Each side of it was planted with 15 pear trees of the variety *Doyenne d'hiver* (Winter Doyen), giving a wall area of 232 square feet to each tree. In 1907 the trees on the south side bore 134 pears, weighing 91 pounds, and the trees on the north side bore 109 pears, weighing 77 pounds. All the pears were of very fine appearance and without blemish, and the pears from the north side were smoother than the others.

In the nursery of Croux et Fils is a glass wall, which is surmounted by horizontal glass sashes and planted with the same varieties of peaches, apples, and pears on each side. These espaliers also began bearing in 1907, and both sides have produced equally fine fruit. The difference in temperature between the sides of the wall is not very great, as the southern face reflects less heat and is therefore cooler than that of a masonry wall, while the northern side is warmed by the rays which pass through the glass. A masonry wall possesses, theoretically, one advantage over a glass wall, as it absorbs during the day a greater quantity of heat, and consequently exerts a greater heating effect at night. Longer experience will be required to determine which material is the better on the whole. The cost of construction is practically the same for both.—Cosmos.

A rust-preventing coating for iron, used by a German manufacturing company, consists in coating iron and steelware first with lead, then electrolytically with zinc, and finally heating this coating, so as to obtain an alloy of the two metals which has the same potential as zinc.

Correspondence.

LATHER AS A TRAP FOR INSECTS.

To the Editor of the SCIENTIFIC AMERICAN:

Here is a little experience that may be valuable to others:

An hour ago, while I was reading my SCIENTIFIC AMERICAN, my room was invaded by a swarm of gnats, and I was unable to continue my reading. Just as I was wishing I had sticky flypaper, I thought of something else. I took a cake of toilet soap and made a quantity of stiff lather, and spread it on some sheets of paper which I laid in the bright light under my lamp. I also covered the top of the lamp around the burner with the lather. In fifteen minutes every gnat had got tangled in the lather, besides a candle moth or two for good measure. As I was reading your paper at the time I thought it might be useful to you, so here you have it. L. L. KLINEFELTER.

Obar (formerly Perry), N. M.

THE POPE AND THE COMET.

To the Editor of the SCIENTIFIC AMERICAN:

I regret that you have published the old fable of the Pope and the Comet. Kindly correct it in the name of truth. (Rev.) H. S. SPALDING, S.J.

Chicago, Ill.

In an article published in Popular Astronomy last October, William F. Rigge considers this subject. He writes:

"It seems that no article can be written on Halley's comet without bringing in the oft-told story of the bull which Pope Callixtus III. so ineffectually launched against it, or of the Angelus bells which were rung to frighten it away, or of the prayers which were to deliver the Christian world from the devil, the Turk and the comet. The truth-loving reader will, therefore, be probably most intensely surprised when he hears that, as an actual fact of sober history, there is no truth whatever in the story, not even in its least details. And the proof is easy and solid.

"First. While Newcomb calls the bull a myth, but along with the Columbian and Chambers encyclopedias believes that prayers were ordered to be said against the comet, no allusion whatever to the Pope, the bells and the prayers is made by Sir John Herschel, Grant, Young, Comstock, Todd, Langley, the American Cyclopedia, the Encyclopedia Americana, the Encyclopædia Britannica of 1902, etc. While this may be a negative argument, it is not, however, an inconclusive one, for why should these eminent authorities, all of them non-catholic, not mention the story if it is true, when so many other writers speak of it?

"Second. The Bullarium Romanum is a large series of volumes containing in Latin most of the official documents ever issued by the popes, from St. Peter down to our own day. Owing to the definiteness of the reference and the short reign of Callixtus III., it was an easy task for me to read all the documents of this pope, and I can attest from my own personal knowledge that not only is there no bull against or concerning a comet, there is not even a paragraph, nor a phrase, nor a word, which might be construed to refer to a comet.

"Third. The story is so universally told and is to be found in so many writers, such as Arago, Draper, Babinet, Guillemin, White of Cornell, etc., that most persons are really excusable when they are misled into the conviction of its truth, and then simply copy it and pass it on to the next generation. If the reader of these lines is really interested in the matter, I would refer him to an able article entitled "Of a Bull and a Comet" written by John Gerard, S.J., and published in The Month, London, in February, 1907. Here the whole story is traced to its fountain head, and it is shown by the best authorities, nearly all of them non-catholic, that not only no bull was ever launched against the comet, but prayers were not even ordered to be said against it, although the prevailing opinion of the scientific men of the time was that the comet foreboded calamity to the earth. Any one that wishes it may obtain a free reprint of the article in question by applying to the Superintendent of Parish Schools, Broad and Vine Streets, Philadelphia.

"Fourth. The article just referred to traces the origin of the whole story about the bull against the comet to this one paragraph of Platina, in his Vitae Pontificum, published in Venice in 1479. As this writer was not only in Rome at the time, but was also archivist of the Vatican when he wrote his history, his authority ought to be of the utmost value. These are his exact words:

"'A hairy and fiery comet having then made its appearance for several days, as the mathematicians declared that there would follow a grievous pestilence, dearth, and some great calamity, Callixtus—to avert the wrath of God—ordered supplications, that if evils were impending for the human race, He would turn all upon the Turks, the enemies of the Christian name. He likewise ordered, to move God by continual entreaty, that notice should be given by the bells to all the faithful, at midday, to aid by their prayers those engaged in battle with the Turk.'

"Let us read the words again and study them carefully. 1. The Pope did not issue a bull against the comet; he ordered supplications. 2. He ordered these conditionally, 'that if evils were impending,' prudently neither admitting nor rejecting the authority of the mathematicians who declared that pestilence, dearth and some great calamity would follow the appearance of the comet. 3. He assumes no authority over the comet nor bids it be gone; he orders supplications, declaring himself to be a suppliant, that if evils were impending, God would turn them upon the enemies of the Christian name. 4. Bells are to be rung to remind the faithful to pray, not to frighten away the comet.

"This one quotation from one author, which has been the germ of the whole comet story, weakened as it is by our simple analysis, becomes of no value whatever when we apply the rules of ordinary historical criticism. We have only the word of Platina that the Pope ordered supplications to be made and bells to be rung; he neither refers to any papal document, nor does he quote the Pope's exact words. Now, as the Bullarium Romanum contains all the official documents of all the popes, and as not one of the declarations of Callixtus III. alludes in any manner whatever, directly or indirectly, to a comet, we have every reason to dismiss the testimony of Platina altogether. For this same reason we must also reject the testimony of each and every writer that mentions the comet story or any of its details, because not a single one of them has ever given the slightest reference to any official document ever promulgated by Callixtus III. whether in the Bullarium Romanum or out of it, nor supported his assertion by anything stronger than a quotation from a previous writer who was equally deficient in his historical proofs.

"There is, therefore, no foundation whatever for the story that Callixtus III. issued a bull against or concerning a comet, that he ordered bells to be rung to frighten it away, and that he ordered prayers to be said to deliver the world from its influence."

THE NUMBER OF OUR ANCESTORS.

To the Editor of the SCIENTIFIC AMERICAN:

If all of one's progenitors had been totally unrelated, each generation back would consist of twice as many persons as the one preceding it. But the true number of one's ancestors would in a few generations cease to even approximate the figures thus obtained.

It is likely that after going back just a few generations, the number of ancestors in each degree would remain fairly constant. In many instances of small, isolated communities, it is possible that the eighth to tenth remove might include the entire community at that time. From that point, the number would bear a definite relation to the population, and would often be a decreasing factor.

It may be inferred, from the persistence of some strongly developed types, that persons of the same ancestry are drawn together by natural selection without any knowledge of their common parentage, as most people's knowledge of their own genealogy becomes hazy when the third generation is passed; in fact, it generally ends there. There is not one person in a thousand that can name all his great-grandparents.

It seems to me the probabilities are that when a generation includes as many as one thousand persons, that number is not likely to be exceeded by any previous generation, and I do not believe that number would be reached ordinarily in less than twenty generations.

The tenth-degree ancestors would number 1,024, if there were no deductions by reason of plural lines of descent from some of them.

F. W. A. shows that the second, third, and fourth degree ancestors may number only four each. Blackstone in his Commentaries on English Law, using a very similar illustration, shows that an indefinite number of generations might consist of but four persons each, and that all the unions might still be legal. Twenty generations of legal ancestors might then comprise only seventy-eight persons, and it seems probable that this number is nearer the truth than the enormous number suggested by the first contributor.

The theoretical number of ancestors in ten generations would be 2,046; but suppose that in each generation from the third to the tenth there was one from whom there were two lines of descent. That alone would reduce the number 492, or nearly one-fourth. The more remote in degree, the greater would probably be the proportional loss by lines running to a common source.

There can be no approximation to the true number that would be more than a more or less shrewd guess—my own is no better than anyone else's—and it is that in twenty generations the total number of one's ancestors is not likely to exceed 20,000, or an average of 1,000 to the generation; and that the number in each preceding generation is more likely to decrease than to increase.

After arriving at the true number of one's ancestors in each degree, if that were possible, the total would be subject to considerable deductions on account of the same person's being an ancestor in several different degrees, as would be the more likely the more remote the relationship. R. L. FLOYD.

El Dorado, Ark.

THE NUMBER OF OUR ANCESTORS AND OF OUR FUTURE COUSINS.

To the Editor of the SCIENTIFIC AMERICAN:

The problem which has been discussed by a number of your correspondents, in regard to the number of our ancestors, while very puzzling, has given rise to another quite as puzzling to my mind and even more disquieting.

It appears evident that to have kept good the number of the human race, or of any other race, each pair must, on the average, have produced two offspring who matured and reproduced themselves in two individuals, and so on; this merely on the supposition that the number of the race remained stationary, although it is generally supposed the human race has increased through the ages. However, adopting the first supposition, as very moderate surely, I cannot escape the following conclusions:

A has two parents, each of whom had one brother or sister, and each of these collateral relatives has two children. Therefore, A has four first cousins or four cousins of his own generation descended from the collateral branches one generation back. Likewise, from the four collaterals to his grandparents he has sixteen cousins of his own generation, from the eight collaterals to his great-grandparents he has sixty-four cousins of his own generation, etc., or in general A has 4^x cousins of his own generation descended from ancestors x generations back.

This gives us startling results. From the ancestors ten generations back A has over a million cousins; fifteen generations back, over a billion; and this takes us back only about five centuries. If we go back another century, or eighteen generations, A must have about 64 billion cousins, and we are still in very modern times.

Now, what has become of all these myriads of cousins? They are not on the earth. Where are they? And worse yet, because it looks to the future, what of A's children? They must have four times as many cousins as he; and his grandchildren must have sixteen times as many. The prospect looks dark to me. I am more concerned about the cousins of the future than I am for the ancestors of the past.

Sugar Grove, Ill. A. T. MICHELL.

WHY DO MAIN SPRINGS BREAK?

To the Editor of the SCIENTIFIC AMERICAN:

Inasmuch as I have had over thirty years' experience in fitting some thousands of main springs to watches, I believe that I may be able to add something to the article entitled "Why Do Main Springs Break?" which appears in your issue of September 4th, 1909.

I have found in my experience that the main spring of new watches break when the watch has been in use only for a few days. The cause may be attributed to the excessively high tempering of the steel, and in some cases to the uneven tempering of the steel. Moreover, any mineral or vegetable oil will corrode the main spring, because of the presence of acids in the oil. During my entire experience, I have never been able to obtain any mineral or vegetable oil free from acid. The only oil that I have used with success is purified fish oil.

I have found that main springs also break into many pieces because the watchmaker has carelessly handled the spring with perspiring hands. Some watchmakers when cleaning a watch steep the main spring, as well as the other parts, either in benzine or kerosene, to save time. This practice will surely cause the main spring to break within a very short space of time, because of the acids in the benzine or kerosene, which penetrate the steel. Even though the spring be afterward oiled with good fish oil, it is sure to break after this dipping in kerosene or benzine.

If a barrel arbor around which the main spring coils is made too small, in time the spring will break close to the center, which is an infrequent occurrence, particularly in modern watches.

When the watch repairer finds that a spring has lost its resiliency, instead of replacing the old spring with a new one, he will sometimes take the spring in his hands and straighten it by drawing it between his thumb and fore finger, thus restoring its resiliency temporarily. At the same time, however, he makes the spring more brittle, and breakage is sure to follow such treatment.

In conclusion, I wish to concur with your contention regarding the breakage of main springs during hot weather, particularly when taking the watch from the pocket and laying it suddenly on a cold marble or iron slab. RICHARD B. SMITH.

New York.

OPEN-AIR ORCHARD HEATING IN COLORADO.

BY W. FRANK M'CLURE.

The 1909 crop of fruit in the Grand Valley in Colorado, from the Palisades above to Loma below, valued at $3,000,000, owes its existence to a unique battle which was waged against Jack Frost at a time when the fruit was at its tenderest age. By unusual generalship and the work of hundreds of enthusiastic volunteers, the temperature in these orchards was actually raised eight and nine degrees over 27 miles of territory, and a precedent was established which will mean much to the future. In California it is said that the temperature has been raised heretofore in some single orchards two or three degrees, but never to eight degrees, and never before has the work been carried on over so great an area. Plans are now on foot to have every bearing orchard in the Grand Valley protected by next season, not that there is any likelihood of frost every spring in this section, but because the protection against possible repetition of this year's experience is considered cheap insurance. Representatives of other fruit-growing sections have also recently visited the Grand Valley, sent there from their several communities to learn more of the recent experiment.

The raising of the temperature over this large area was accomplished by means of some 300,000 smudge pots of many different types, some burning oil for fuel and some coal, and placed at intervals in the orchards after the manner shown in the accompanying photograph. Oil was carried to the pots in wagon tanks equipped for the purpose. Spraying machines were also used in distributing the oil. A large supply of lighters was kept in readiness in a dry place. Many of these lighters were made by wrapping waste about a twisted wire.

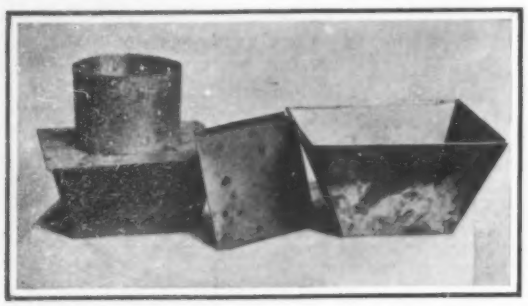
All operations were directed from Grand Junction. Weather stations established over much of the territory, and equipped with thermostats, when the threatening weather arrived, made half-hourly reports on the temperature to Grand Junction.

When finally the danger point was approaching, warning was sent to all the ranchmen to light the fires. Volunteers also in nearly all walks of life made their way in automobiles and wagons and on bicycles over the entire area. The Trades and Labor Assembly adjourned its meeting, and worked all night rendering assistance. Men worked in shifts, some at night lighting the fires, and others in the daytime filling the pots. Even women assisted in the work. The campaign in all lasted four days.

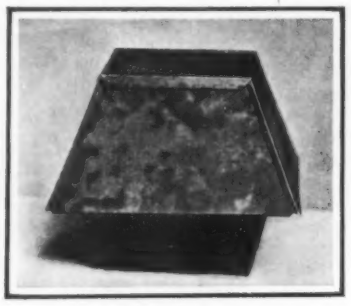
So well did this orchard-heating idea work, that while the temperature outside the heated area dropped as low as 20 degrees, within the heated area it did not go below 29½ deg. Seventy-five per cent of all the fruit trees which were in bloom were cared for directly, while even orchards owned by those who were skeptical of the idea were saved by the fires in the adjoining territory.

As previously stated, there were a great many different kinds of pots used in this work. The number used per acre depends upon the size. Forty, 60, or 80 pots per acre was the average. When coal is used, it is usually lump or nut. With coal at $4 a ton, some one has figured that it cost him $4 per acre to heat his orchard for a six-hour run. Some of the oil heaters are used to the number of 60 or 80 to the acre. In the opinion of some, it is better to have a small-sized pot and use more to the acre, say 60 or 80, as just stated.

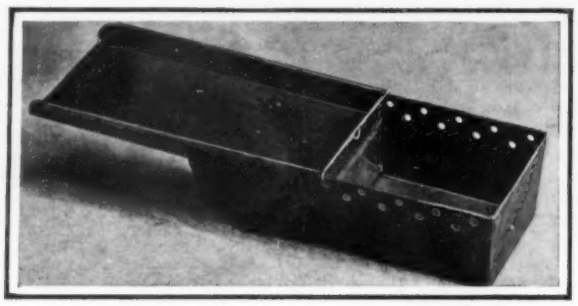
Taking one of the many kinds of pots as an example, and figuring coal at $4 a ton, the cost of equipping with heaters and all other facilities for the first year for ten acres is estimated at $449.25, and for the second year $186.25. This provides in the initial cost for 800 heaters, or 80 to the acre. It also provides for 40



One of the many different styles of pots used in smudging.



An oil pot with hood in place.



Another type of pot in which oil is used.

Spraying the trees with apparatus which also conveys oil to the pots.

Raising the temperature in a Colorado orchard.

A photograph taken late in the evening, showing coal pots with draft covers set.

Typical Colorado orchards; young trees in the distance.

OPEN-AIR ORCHARD HEATING IN COLORADO.

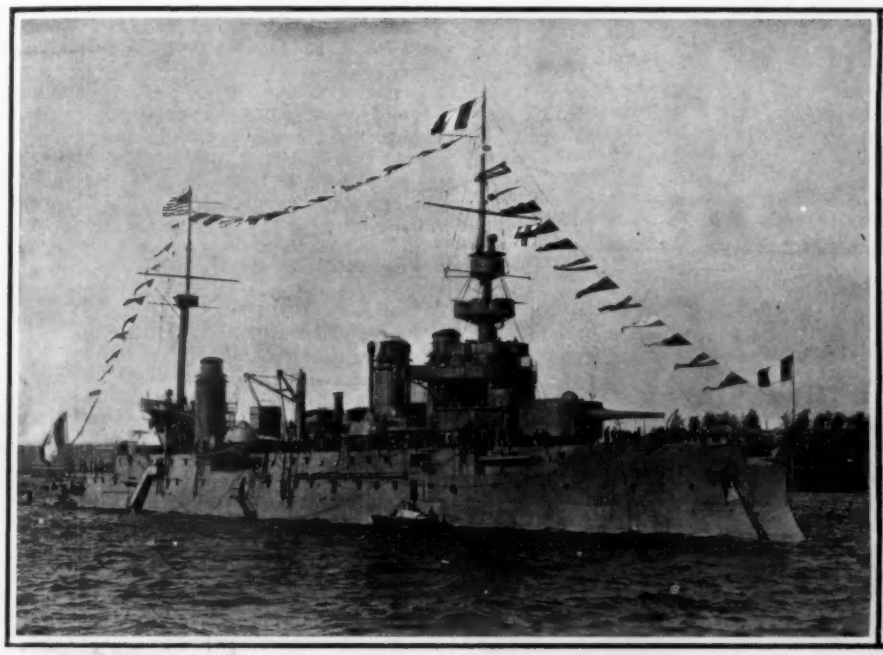
tons of coal, kindling lighters, 50 pounds of waste, 200 gallons of oil for lighting, the storage for oil, and the building of a coal house. For the first year's equipment for oil pots, including 800 pots for ten acres, and fuel at 5 cents a gallon, the cost is estimated at $494.25, and for the second year $153.75.

Now that the question of raising the temperature even 10 or 15 deg. over a large area has been settled beyond doubt, the next problem facing the fruit growers is that of regulating the temperature and economy of fuel and labor. For example, there is no need of raising the temperature 10 deg. when raising it 2 deg. will put the blossoms out of danger. Some are planning to meet this problem by having a large number of small pots and only light enough of them to keep the temperature above the danger point. Others have devised pots with a system of drafts, so that the heat may be increased or decreased as is necessary.

The fruit ranches of the Grand Valley are very extensive. One, for example, contains 243 acres, and is valued at a quarter of a million dollars. Its crops include peaches, apples, pears, plums, cherries, and soft-shell almonds. An army of people is required to pick the fruit. By another season it is expected electric lines will be running out to the orchards all over the valley, and refrigerator cars will be carried right to the orchards.

THE VISITING WARSHIPS—A COMPARISON.

Because of incompetence in its management the naval parade, which should have been one of the most attractive features of the Hudson-Fulton Celebration, came very near being a complete failure, and it was only redeemed by the fact that its line of travel lay parallel with the finest assemblage of warships that was ever gathered in the waters of the Western Hemisphere. The very devil of mischance seemed to have been abroad on the morning of September 25th, and he became busy at the very outset, when the "Half Moon," in a laudable endeavor to show herself under sail, had no sooner spread her canvas, than she plumped squarely into the "Clermont," and came very near ending the career of that little craft there and then. The two great errors which made the parade a failure were, first, the anchoring of the "Half Moon" and the "Clermont" off 110th Street, instead of sending them under tow around the whole line from 42nd to 205th Street; and secondly, the failure to dispatch the commercial steamers, tugboats, yachts, etc., two or three abreast and with reasonably short intervals between them. As it was, a vast part of the visitors both ashore and afloat, all, in fact, who were above 110th Street, never caught a glimpse of the two vessels, the "Half Moon" and the "Clermont," in whose honor the parade was being held. Instead, for them, the procession consisted of a lot of detached and widely separated passenger steamboats, big and little, which



Displacement, 14,900 tons. **Speed,** 19.4 knots. **Guns:** Four 12-inch; ten 7.6-inch.

French Flagship, "Justice."

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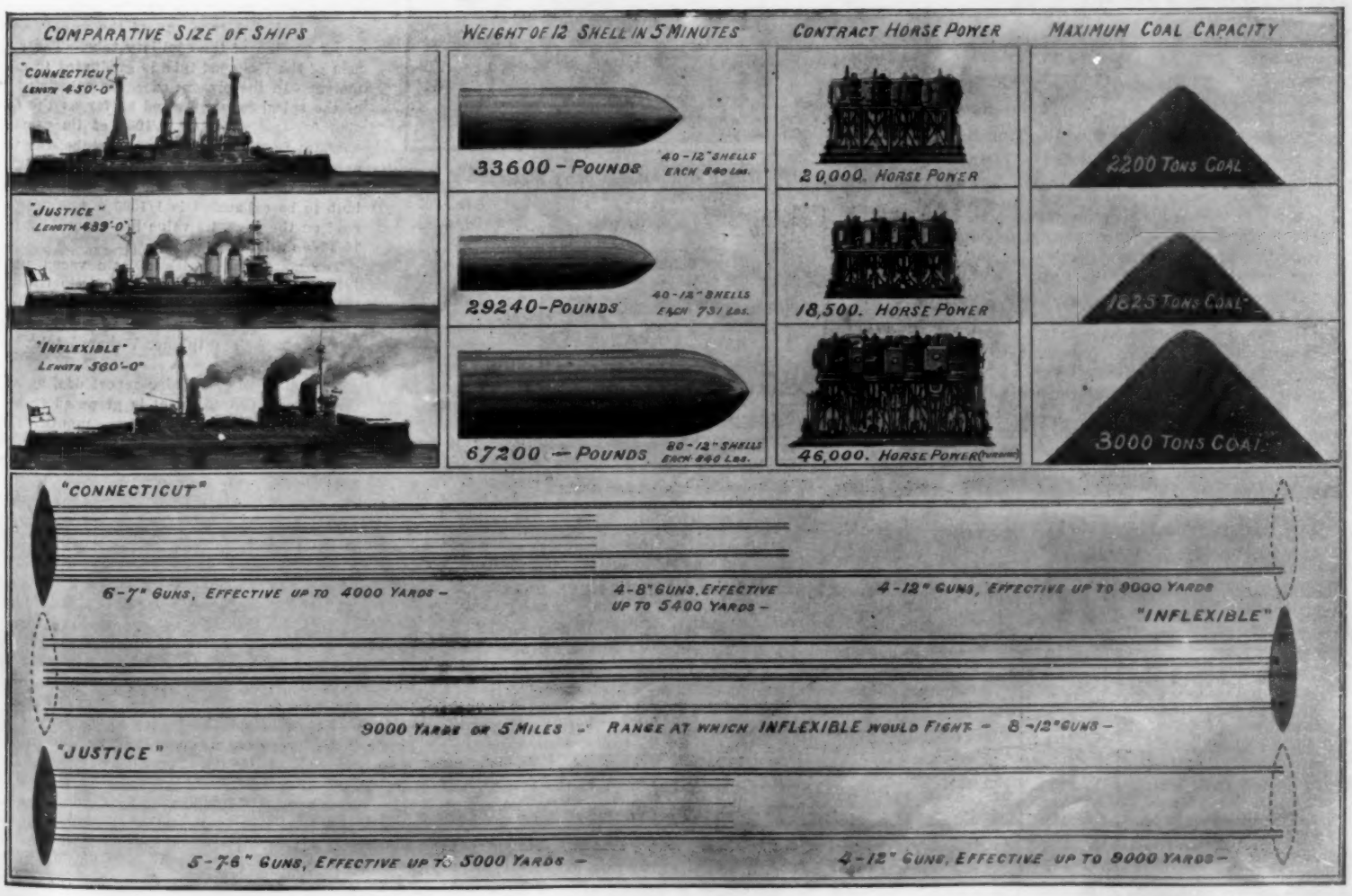
The "Half Moon" under sail in the Lower Bay, New York.



In an engagement with the "Connecticut" and "Justice" the "Inflexible" would try to fight outside the armor-piercing range of their secondary batteries. These batteries, however, would cut her unprotected parts to pieces.

THE VISITING WARSHIPS—A COMPARISON.

steamed leisurely around the fleet—vessels with which the majority of the spectators were already perfectly familiar, from the "Hendrick (*sic*) Hudson" down to our venerable friends the "Iron Steamboats."

It was the noble line of warships, nine miles in length, however, that saved the day. At the head of the line, above Spuyten Duyvil, was the turbine-driven 26-knot scout cruiser "Salem." Astern of her were the armored cruiser, "New York," the flagship of Admiral Sampson during the Spanish war and now fresh from a one million dollar overhaul, in which she has been brought as far up to date as a ship of her age can be. Then there was the "North Carolina," a handsome modern armored cruiser of the pre-"Dreadnought" period. Below these in majestic array came the sixteen battleships which made the memorable voyage around the world. Astern of these was the "Dreadnought" cruiser "Inflexible," the largest and most up-to-date warship in the fleet, with her three armored cruiser consorts, the "Drake," "Duke of Edinburgh," and "Duke of Argyll." Following these were the quaint wooden training ship "Portsmouth" and the Dutch protected cruiser "Utrecht," which was anchored in the position of honor opposite the water gate at 110th Street, where the official reception of the "Half Moon" and "Clermont" took place. Then came the four armored cruisers "Victoria Luise," "Hertha," "Dresden," and "Bremen," representing Germany. Astern of these followed what in some respects was the most imposing of the foreign display, namely, the first-class battleships "Justice," "Verité," and "Liberté," flying the flag of France. Astern of these were the protected cruisers "Etna" and "Etruria" of Italy; the training ship "Presidente Sarmiento" of the Argentine Republic; the gunboat "Morales" of Mexico; the U. S. gunboat "Newport," with the President's yacht "Mayflower" forming the last ship of the line.

THE "CONNECTICUT," "JUSTICE," AND "INFLEXIBLE"—A COMPARISON.

Of the many navies represented at the Celebration, there were three which contained fighting ships of sufficient powers of offense and defense to be placed in the first line of battle, namely, the French, British, and our own. It is impossible within the limits of the present paper to discuss in detail the various units which made up this nine-mile line of warships, with which most of which the readers of the SCIENTIFIC AMERICAN have already been made familiar. We will therefore take the three flagships, the battleship "Connecticut" of the United States navy, the battleship "Justice" of the French navy, and the "Dreadnought" cruiser "Inflexible" of the British navy, and compare their fighting power under those conditions of long-range fighting under which, we are told, modern battleship engagements will be fought.

The theory upon which the latest battleships of our own and modern navies are being designed, and according to which the crews are now being instructed in target and battle practice, is based upon the belief that future engagements will be fought at extremely long ranges, probably of five miles and over. Now, the most accurate gun, and the one that can inflict greatest punishment at long ranges, is the big gun, and the bigger the gun the more accurate and deadly the fire. It is in this fact that we find the explanation of the modern "Dreadnought," which is armed entirely in its main battery with the 12-inch gun, the exception being the German navy, which makes use of an 11-inch piece. Now, the determination of the range at which a battle shall be fought lies with the ship which possesses the greatest speed; for, if the enemy should attempt to close in, the faster ship is always able to draw away. On the other hand, if the enemy should wish to increase the range or draw out of the fight altogether, the faster vessel can still maintain the range, and place herself on whatever

COMPARISON OF "CONNECTICUT," "JUSTICE," AND "INFLEXIBLE."

	"Connecticut."	"Justice."	"Inflexible."
Navy type	United States Battleship.	France Battleship	Great Britain Cruiser-Battleship.
Length	450 feet.	439 feet.	567 feet.
Beam	76⅞ feet.	79½ feet.	78½ feet.
Draft	26¾ feet.	28 feet.	38 feet.
Displacement	16,400 tons.	14,900 tons.	17,250 tons.
Horse-power	20,000	18,550	50,000
Trial speed	18.8 knots.	19.4 knots.	28 knots.
Coal supply	2,900 tons.	1,885 tons.	3,000 tons and 700 tons oil.
Main Battery	Four 12-inch.	Four 12-inch.	Eight 12-inch.
Secondary battery	Eight 8-inch. Twelve 7-inch.	Ten 7.6-inch.	.....
12-inch gun protection	12 to 10-inch.	12½ to 11-inch	10-inch.
Secondary battery protection	7 to 6-inch.	5½-inch.	.....
Belt armor	11 to 4-inch.	11 to 7-inch.	7 to 4-inch.

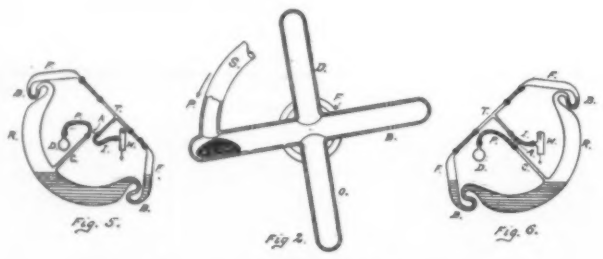
(Continued on page 271.)

A NOVEL AIR PUMP AND VACUUM GAGE.

BY THE BERLIN CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The most indispensable auxiliary of the physicist intent upon investigating those mysterious radiations the study of which is becoming more and more important is doubtless the air pump. For that reason many scientists and engineers have endeavored to improve the existing types of air pumps and have designed novel systems. One of the most interesting is that invented by Dr. Von Reden, of Franzburg, near Hanover.

This is a mercury pump, the design of which will be most easily understood by reference to Figs. 5 and 6. The pump consists of a tube filled one-half with mercury, as indicated by the shaded portions. This tube is provided at its two ends with S-shaped tubes



Various positions assumed by the vacuum gage

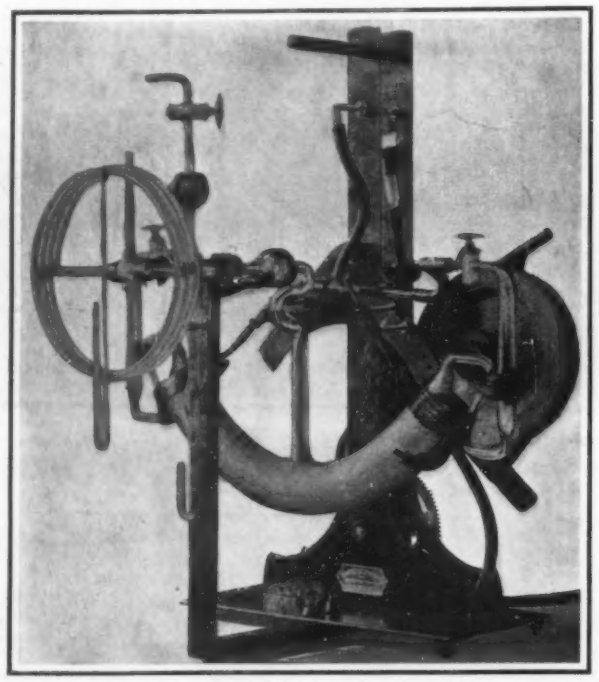
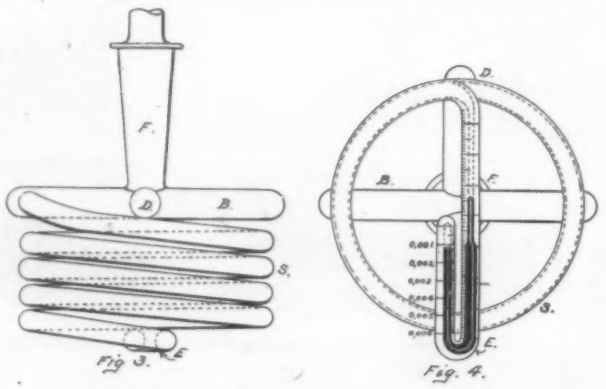


Fig. 1.—The Von Reden vacuum pump and gage.



Spiral glass tube attached to two cross tubes.

A NOVEL AIR PUMP AND VACUUM GAGE.

B, and at its middle with a straight tube *C*. The S-shaped tubes are connected on both sides to widened portions *F*, connected by rubber tubing with a T-shaped tube and thence by tube *I* with a water supply *W*. The straight tube *C* and the bulb *D* to be exhausted are connected by a rubber tube *P*. The entire apparatus turns round a pivot *A*.

After having produced a preliminary vacuum (of about 20 millimeters of mercury) in the bulb *D*, and the apparatus, by means of the water pump *W*, the apparatus is oscillated from the position represented in Fig. 5 to that of Fig. 6 and back. The mercury remaining in the S-shaped tubes *B* acts as a pressure valve, and prevents the air in the enlarged portions *F* from returning to the tubes *R*. On the other hand, the air entering from the bulbs *D* in both positions through *C* is driven by the mercury toward the widened portions of the apparatus through the right-hand and the left-hand S-shaped tubes respectively, in order to be eventually discharged by the water pump. The connecting tube *P*, which, owing to its porosity, would not be very efficient, is advantageously replaced by a connection consisting of ground-glass joints in the shape of perforated glass balls, fitting tightly in the carefully polished hemispherical cap, as shown in a halftone illustration, Fig. 1. In order to connect the ball with the cap, metallic springs may be employed.

Fig. 1 represents to the right a turbine belted to a pulley, which oscillates the tube by means of gearing and a crank mechanism. The glass ball joints lead to the spiral vacuum gage and the joint provides a connection with the bulb to be exhausted. A short-arm manometer is mounted below the bulb.

The pump above described can exhaust within three minutes a bulb of about 500 cubic centimeters capacity (a preliminary vacuum having been previously obtained by means of a water pump) to 1/100 of a millimeter of mercury; in four minutes, to 1/1000; in five minutes, to 1/10,000; and in thirteen minutes, to 1/100,000 millimeter of mercury, the lower handle being turned at the speed of six revolutions per minute. All the air should be expelled from the two vacua *F*, in order to obtain the vacuum last named. This is effected when the pump has been given its maximum inclination by means of the mercury, which on entering the apparatus throws back any residual air through the cocks *H* and *H'*, closed rapidly after the tube *R* has been kept oscillating for seven minutes. The pump is stopped only for a very short time.

The vacuum gage represented in Figs. 2, 3, and 4 consists of a spiral glass tube attached to two cross tubes (Fig. 2). The left-hand tube *B* incloses a small amount of mercury, and the cross tubes *B*, *D*, *O* are mounted on a standard ground-glass joint, the conical angle of which is accurately given.

By turning the spiral round on the axis of the joint *G* in the direction of the arrow *P* (Fig. 2) the small amount of mercury represented at the left of Fig. 2 is made to enter the spiral, there compressing the exhausted air, until after a number of revolutions it enters the U-shaped tube *E* of Fig. 4, in order there to occupy the position marked. The left-hand arm of the U-tube is so graduated that the divisions 0.001, 0.002, etc., to 0.006, limit 1/1000, 2/1000, etc., to 6/1000 of the total capacity of the U-shaped tube and of the spiral in the upper portion of the capillary tube. The right arm of the U-shaped tube is graduated to millimeters. In the present case, the exhausted air of the spiral is compressed as far as the division 0.001; that is, to 1/1000 of its previous volume; in the right arm of the tube, the mercury takes up a position 16 millimeters higher. As, however, the atmospheric pressure in the bulb to be exhausted is 1/1000 of the pressure read on the gage, its value has accurately been 16/1000 millimeter.

The spiral gage will indicate vacua up to 1/10,000 millimeter. The only distinctive feature of the one used in measuring a vacuum of 1/100,000 millimeter is its being provided with a longer spiral and thinner U-shaped tube.

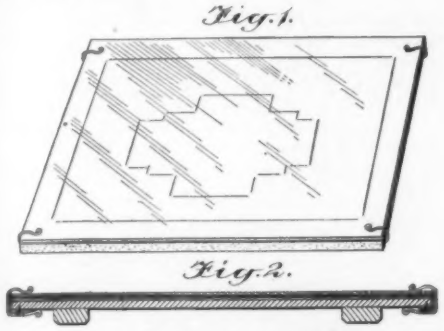
According to a consular report dealing with the trade of Chinkiang, it is proposed to build a railway from Kuachou, at the mouth of the Grand Canal, to Tsingkiangp'u and Hsüchoufou, and thence joining the Peking-Hankow line *via* K'aifêngfu. This line has been surveyed, and the money is being asked for among Chinese merchants. The enterprise, the report states, is to be purely a "people's undertaking." The Chinkiang-Hsüchoufou-K'aifêngfu portion is to be laid first, as the canal provides a temporary transport for goods from Tsingkiangp'u southward, and therefore this portion is not so pressing. The line is to be finished in four or five years. If the Tientsin-Pukow line gets into working order first, a great deal of the trade of Chinkiang must go to Nanking, and may never be recovered. But although the future prosperity of this port would seem to depend upon the new line in question being ahead of the Tientsin-Pukow line, the wealthy merchants of Chinkiang and Yangchow and other places seem still reluctant to subscribe the necessary capital, nor will they consent to a foreign loan, however favorable in terms. It was hoped that this being a "people's line"—the Tientsin-Pukow line being official—would commend itself to the merchant class, but the reason for want of support is to be sought in the want of confidence when large sums are to be placed in the hands of a few "managers."

Handy Man's Workshop

SIMPLE BLUE-PRINTING FRAME.

BY C. L. SWEEZEY.

For those desiring to make a few small blue prints, and having no regular printing frame, the following may prove useful.



SIMPLE BLUE-PRINTING FRAME.

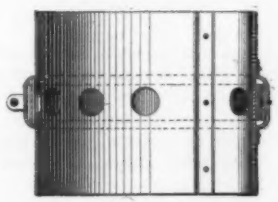
Secure a piece of ordinary window glass, somewhat larger than the largest blue print desired. If a piece the same size as your drawing board can be secured, it will be very convenient. Bind the edges of the glass with adhesive tape, to prevent scratching the tracing or hands. Cover the drawing board with felt or other heavy cloth, drawing the covering over the edges and fastening with thumb tacks. Make four clips, as shown in the accompanying illustration, using thin spring brass or wire. The exact size of clips depends on the thickness of board and glass.

In use the sensitized paper, which can be obtained from dealers in photo supplies, is laid on the felt, coated side up, the tracing to be copied is placed in position and covered by glass, which must be clean, then the clips which hold the whole in position are slipped on at the corners.

THERMOSTATIC REGULATOR FOR SMOKE PIPES.

BY B. A. JOHNS.

The accompanying illustration shows a simple way in which to make a thermostatic regulator that will automatically open passages in the smoke pipe, to admit cold air, thus checking the draft of the furnace, and eventually cooling off the fire. The regulator should be placed as near the furnace as possible. Fig. 1 shows a sectional side elevation of the thermostatic regulator, and Fig. 2 a horizontal section of same. In a short piece of pipe, say about 6 inches long, a number of openings are made. These openings



REGULATOR FOR SMOKE PIPES.

are covered with the thermostatic band, which is made as follows: A ring about 2 inches wide, and about 1 inch larger in diameter than the pipe, is made of galvanized iron. The edges are turned down by hammering, as shown in Fig. 1. These turned-down edges are fitted closely to the pipe. In the recess thus formed, a strip of brass or preferably copper is fitted and riveted very closely, say about 1 inch apart, so that when the copper expands, it will not buckle.

To the above-mentioned galvanized ring, opposite the joint, small lugs may be provided for the purpose of fastening same to the pipe. The ring is now cut at the joint, and the ends turned in and fitted closely to the pipe. Two small lugs are riveted to these ends of the ring, with holes to receive a small stove-bolt. Between the head of this bolt and the lug on one side, place a stiff coil spring. This serves the purpose of regulating the tension of the ring, so as to make it more or less sensitive to heat.

As the fire gets too hot, the copper expands more than the iron ring, causing it to move away from the pipe, and cold air from the outside will pass between this ring and the pipe into the holes of same, thereby checking the draft to the furnace, and preventing it from over-heating.

Under normal conditions, of course, the spring does not open, but only under excessive heat; then it will stay open until the furnace cools off.

CIRCULATING PIPE FOR HOT-WATER FAUCETS.

BY J. A. BERGSTROM.

In turning on a hot-water faucet, it is always necessary to let the water run for some time before it gets hot. The cause of this is that the water standing in the pipe soon cools off, right up to the boiler, owing to the fact that there is no circulation in same, and of course a great deal of water is wasted. It is an easy matter to overcome this by connecting the back of the faucet to the bottom of the boiler with a small

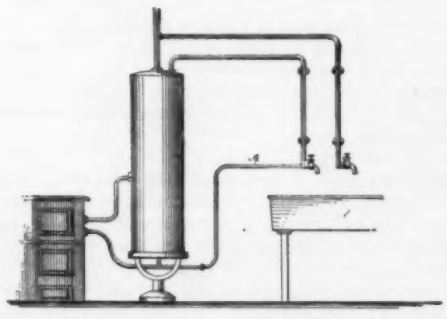


Fig. 1

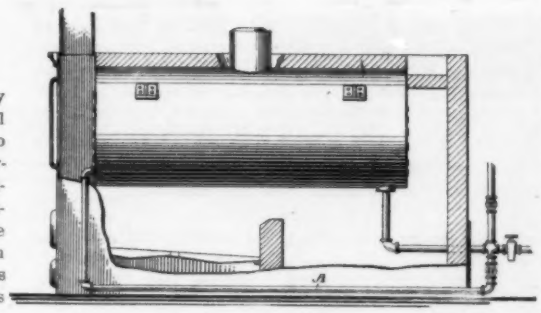


Fig. 2

CIRCULATING PIPE FOR HOT-WATER FAUCETS.

pipe *A*, shown in the accompanying drawing, Fig. 1.

It is now evident that as soon as the hot water in the supply pipe cools off, owing to the change of specific gravity, it will pass downward into the circulation pipe and back to the boiler; and of course a fresh supply of hot water will flow constantly from the boiler to the faucet, and will keep up as long as there is a difference in temperature at the top and bottom of the boiler.

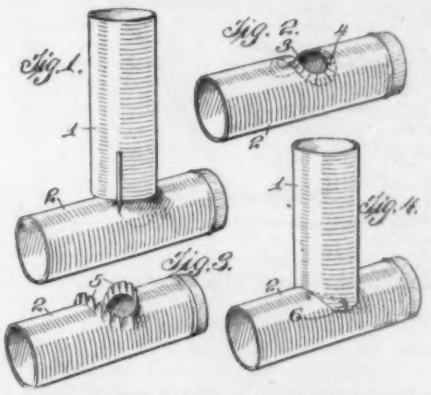
This also holds good in a steam boiler. Fig. 2 shows an ordinary horizontal tubular boiler. Most of these boilers are fed through the blow-off pipe. This pipe is considered a weak part of the boiler, owing to the fact that the boiler is not fed constantly, but at intervals. Therefore these pipes are always required to be covered with asbestos, and sometimes protected from the hot gases by a brick wall. If the boiler were fed constantly, that is to say, if there were a circulation of water in this pipe at all times, the gases would have little effect on same. As soon as the feed water is shut off, or rather between the intervals of feeding, this pipe is full of water, which cannot circulate, and is liable to be overheated and burn. To overcome this, a circulating pipe *A* is connected inside the blow-off cock to some part of the boiler, say to the lower part of the front end. A check valve may be inserted into the line, to prevent the feed water passing through the same. This pipe will at all times establish a circulation in the blow-off pipe, and eliminate all danger of being burned out.

HOW TO CONNECT STOVE PIPES.

BY H. G. L.

The man who desires to connect two stove pipes together and has not the tools ordinarily used for this purpose can do the work as follows:

Place one end of pipe 1 against the side of the pipe 2 at the point where it is to be connected. With pencil flat against the side of pipe 1, as in Fig. 1, trace off the curve on pipe 2. Leaving about 1 inch margin, cut out a disk 3, slit the margin back to the line as at 4, and turn up the tangs 5. Force the end of pipe 1 through the opening, and trace off the curve of pipe 2. Withdraw pipe 1, and cut off the end as marked. Now fit the pipe 1 into place with the tangs



SIMPLE METHOD OF CONNECTING STOVE PIPES.

5 on the inside, and bend the tangs up to a tight fit. If carefully executed, the joint will be sufficiently tight for all purposes.

To hold the pipes rigidly together, punch small holes through the opposite sides with a sharp punch, and put in a piece of stiff wire 6. Bend the ends of the wire on the outside. The wire should pass through the tangs on the inside.

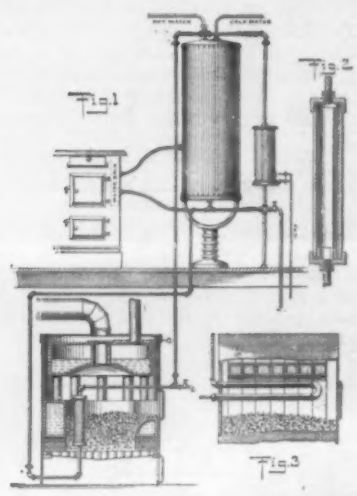
HOT-WATER CONNECTION FOR KITCHEN BOILERS.

BY JOHN B. ALLEN.

In houses where the cooking is done exclusively by gas, and with no fire in the kitchen range, in the winter, the question of having hot water in the kitchen boiler has been quite a problem in many a household, especially as it is very expensive to heat this water by gas.

One solution of the problem is to connect the heating apparatus in the cellar with the kitchen boiler, and if this be done properly, there will be an ample supply of hot water at all times; in fact, more than needed in extreme cold weather, besides keeping the kitchen warm, in the absence of any other source of heating. Of course, a steam or hot-water radiator, placed in the coldest part of the kitchen, will improve conditions in severe weather.

It must be understood that it takes a little more coal to run the heating apparatus, although some contend that it does not. Fig. 1 shows a steam boiler in the cellar, connected up with the kitchen boiler, also a separate gas heater, for use in the summer. It will be noticed that there are three independent circulations for the water, which will not interfere with



CONNECTING THE KITCHEN BOILER TO THE FURNACE.

each other—the circulation from the kitchen range, the one from the furnace, and the other from the gas heater. The connection from the furnace, steam, or hot-water heater in the cellar or basement, may of course be varied according to local conditions. The accompanying illustration shows two good and reliable ways of making the connection. Assume that the kitchen range is connected to the boiler in the usual way; then the connection with the furnace is made

as follows: Unscrew the hot-water connection on top of the boiler, and insert a street cross; if this cannot be obtained, two street tees will answer the purpose. Then replace the hot-water connection in this cross, as before. From one of the side outlets of this cross run a pipe line to the furnace, and from the other to the gas heater. It is well to start and finish the lines with a union, as it is then an easy matter to disconnect them in case the kitchen boiler gives out, or any repairs are needed. The line from the boiler is run from top of same into the furnace, thence down through the fire pot and grate, in such a manner that it does not interfere with the proper working of the latter. Thence through the side of the ash-pit, and up to the bottom of the kitchen boiler. It is now evident that as the water in the heating pipe inside the furnace is heated, it rises, and fills the top of the boiler, forcing the cold water out at the bottom.

HOW TO CONVERT A PAIR OF OVERALLS INTO A TOOL BAG.

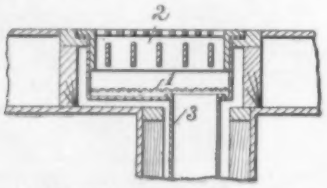
Fig. 2 shows a cross section of the heating pipe, inside the furnace. It consists of a short piece (say 2 inches) of extra heavy black pipe, threaded at each end to receive reducing caps, which connect with the pipe line. Inside this pipe is another, 1½ inches in diameter, which leaves only a small space for the water to circulate in; that is to say, the water is spread out in a very thin sheet, which very easily heats. Three small sections on top and bottom of this pipe, about ⅛ inch wide, are turned outward, so as to fit the inside diameter of the outside pipe, and thereby keep it central. Outside the furnace is placed a faucet or stop-cock, so that the sediment may be drawn off, which should be done at least once a week.

Fig. 3 shows the other arrangement of a heating pipe inside a sectional boiler. In the back of the boiler, over the fire line, drill two holes, about 3 inches above each other, into which insert the pipes, about 2 inches in diameter, reaching nearly across the entire fire space. Connect the same with a return ell, or make it up with ordinary pipe fittings. At the outside of the boiler, reduce these pipes to the regular size used for the pipe line, which is usually ¾ inch in diameter. Attach a faucet to the lower one, and connect it to the bottom, and the higher one to the top of the kitchen boiler. Care should be taken, in running the hot-water pipe from the boiler, not to trap it, that is to say, not to let it drop on the horizontal run, but rather give it as much of a rise as possible. If the run from the furnace to the boiler is very long, the hot-water pipe may be covered with asbestos or the like. A stopcock may be put in either or both lines, so that the water can be shut off, in case of repair. The gas heater is connected at the top and bottom to the top and bottom respectively of the boiler.

A SCREEN FOR THE REGISTER.

BY J. A. BROPHY.

A simple and very effective means for preventing articles dropped on the floor from falling down the hot-air pipes is shown in the accompanying illustration. Cut a piece of wire mosquito netting, 1, the size of the floor opening. By lifting out the floor register, 2, the netting can be placed over the opening in the hot air pipe, 3, as shown. Better still, bend a piece of stiff wire to the shape of floor opening, and after turning the edges of netting over this frame, sew the netting to the frame with fine wire. Galvanized wire netting is preferable to the painted netting. The writer has been able by this method to reclaim several articles of value that had dropped into a floor register.



A SCREEN FOR THE REGISTER.

THE BOILER MAKER'S TOOL BAG.

BY A. F. BISHOP.

When the boiler maker gets a rush order for repairing a boiler he gets busy. Quickly converting his overalls into a tool bag, he drops in half a dozen chisels, expander, hammer, etc., and then he is ready for action. In making the bag he places the overalls full length on the floor, folds one leg up and lays it on the seat of the overalls, then rolls the two very tightly together, criss-crosses the suspenders and ties them on the part which appears in illustration. He then puts his hand inside the leg left full length and grasps the roll and turns the whole thing inside out. This completes the bag which is ready to receive the tools, which, of course, come against the outside of the overalls, leaving the side that comes next to his garments as clean as ever.

COATING ROOFS WHITE TO REPEL HEAT RAYS.

BY A. J. JARMAN.

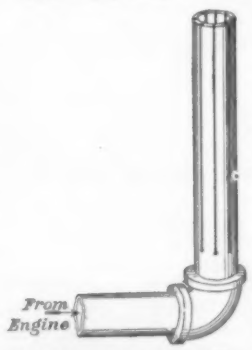
The almost general practice of painting the metal covering of the roofs of houses with the red or chocolate-colored oxide of iron, is one of the causes of the insufferably high temperature of top rooms or attics during the summer months. Although good as a covering for metal, this paint because of its color absorbs the heat rays and conducts the heat to the interior. The roof-covering material is not always metal. If tar paper or tar felt and gravel have been used, no kind of white paint will retain its color upon them. If the covering is zinc, this metal is apt to prevent the adherence of paint, particularly when new. Although white paint made with oil and driers can be used upon a roof previously covered with chocolate-colored paint, another material must be used for a tar and gravel roof. To secure a thoroughly adhesive coating upon new zinc, brush over the metal the following mixture: Sulphate of copper two ounces, chloride of copper two ounces, salammoniac two ounces, water one gallon. When the salts have become dissolved, add two ounces of spirit of salt (common hydrochloric acid). Allow this to dry upon the zinc for about twenty-four hours, when it will be found that any kind of oil paint will adhere perfectly to the zinc.

For a tar roof, use a freshly-made mixture of lime wash, moderately thick and hot. Two coats of this will adhere firmly to the tar, and retain its white color, as well as becoming very hard and resisting rain without washing off. If the lime mixture has become cold, the hardening property will be lost. In that case, to every pailful add a double handful of common salt. Stir in well until dissolved. This will revive the hardening quality. The interior of the rooms with roofs painted or lime-washed as above, will be found from ten to twelve degrees lower in temperature.

A MUFFLER FOR GAS ENGINES.

BY ALFRED P. MORGAN.

The handy man who has a gasoline engine in his shop and which exhausts outside into the atmosphere may silence that disturber of the peace somewhat in the manner shown in the accompanying illustration. It removes the sharp penetrating quality of the noise without causing any back pressure. The end of the exhaust pipe, which must be vertical in order to prevent clattering of the segments, is split into eight parts by means of longitudinal cuts made with a hack-saw. The cuts should extend for three or four feet in the pipe.



SLOTTED EXHAUST PIPE SERVES AS A MUFFLER.

TO PREVENT COAL GAS.

BY L. G. HANDY.

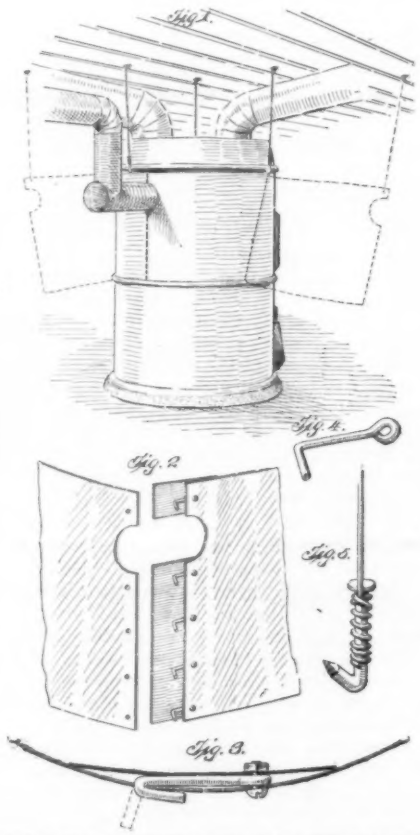
The extremely objectionable presence of coal gas in a furnace-heated house is really a simple thing to prevent. It is due, of course, to leaks in the air ducts through which the gas generated in the furnace enters and mixes with the fresh air that passes to the rooms above. To gain access to the interior of the furnace so as to stop the leaks may appear to be a task quite beyond the average amateur's capabilities, but the accompanying drawings show how the writer succeeded in doing the trick in a simple way.

The top of the furnace, carrying the heating pipes, rested upon a cast iron ring and it was a simple matter to raise the whole thing bodily by the arrangement shown. Three strong hooks were made out of large nails and under the head of each a piece of stout wire was fastened. The hooks were slipped under the iron ring. The ring was raised and the wires wound upon heavy nails driven into the beams overhead.

A 1-inch lift was sufficient and did not interfere with the heating pipes in any way, but relieved all weight from the main band of the furnace and left it free to be laid open. This was done with a pair of tinner's shears. The band was simply slit at the back where the heavy dotted line appears on Fig. 1. The two ends were spread apart and temporarily supported by wires to the rafters. The entire interior of the air box was now accessible.

Several open cracks were found. Through these the gases of combustion had passed freely into the fresh-air compartment and thence to the rooms above. A can of asbestos cement was obtained from a hardware dealer. All surplus rust was scraped off from around the cracks with an old knife and the cement was applied freely. Care was taken to squeeze enough into the cracks to insure a good hold. All cracks were treated in this way and the important part of the job was finished.

To reconnect the ends of the band five small holes were punched an inch from each of the two edges and exactly opposite each other. From a piece of heavy iron wire five hooks were bent to the form shown in Fig. 4. These hooks each measured 2 inches from the center of the eye to the bend. A strip of galvanized sheet iron about 8 inches wide was punched with holes to correspond to those in one end of the band. Small bolts, about ⅝ inch long, were used to bind all firmly together. The free ends of the hooks were now passed through the holes in the opposite end of the band and bent down. The strip of sheet metal on the inside formed an effective seal, as clearly shown by the section, Fig. 3.



METHOD OF REPAIRING A LEAK IN THE AIR DRUM OF A FURNACE.

The band being closed, the top was now lowered, and the furnace was ready for use. The whole job consumed slightly over three hours.

The cement may need to be removed next year, and, to facilitate this task of the future, the hooks were conveniently looped up into the rafters. The back may be readily reopened by bending up the ends of the hooks, and to repeat the work should not take more than an hour.

Since this job was completed, my fire has been made three times without the slightest trace of smoke or gas in the house.

In the Revue de Métallurgie, Le Châtelier advocates autogenous welding for the repairing of marine boilers. Referring to the important work that has been done, especially in Germany, in the welding of fire-boxes to boilers by the aid of water gas, he expresses the conviction that the same work could be done better by the autogenous process. A large French shipbuilding company is employing the process in order to dispense with riveted joints in the parts of boilers that are exposed to fire heat, and in one case, it is stated, the bracket supporting the grate of a boiler has been replaced by a fitting welded to the metal of the grate and of the fire-box.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

HOOK AND EYE.—C. S. LICHTENSTEIN, New York, N. Y. The more particular purpose of the invention is to improve the construction of both the hook and the eye for the purpose of improving the locking connection therebetween, so as to render the hook and eye rigid relatively to each other when in position on a garment.

Electrical Devices.

AUTOMATIC TEMPERATURE-INDICATOR.—W. E. CAMPBELL, Chester, S. C. The invention relates to devices for automatically indicating a predetermined temperature. It provides a temperature indicating device whose operating parts consist of metal and which is not subject to the danger of breakage like the thermostats which have the common glass tube filled with mercury.

KNOCKDOWN ARMATURE.—E. W. PRESBREY, New York, N. Y. This armature is mounted in a field core within permanent magnets, and gives a high potential current of unusually steady character with a low number of revolutions. It is in no danger of burning out its coil at high speed, and consequently it needs no governing or protecting device. Its capacity can be changed by the removal of the single screw and substitution of another coil of any size of wire.

Of Interest to Farmers.

CULTIVATOR.—N. TRIPP, Grand Rapids, Mich. This cultivator pulverizes the soil and whips the dirt from the roots of weeds, etc. The drum has spring digging teeth which incline oppositely to the revolution of the drum, whereby they will be lifted rapidly from the ground on reaching a vertical position. The motor for driving the drum is carried on a wheel-supported bed, and the drum is journaled in a frame which is pivoted at its front to move vertically relatively to the bed when raising the cultivator above, and lowering it to the ground.

RIDDLE FOR ROOT-EXTRACTORS.—B. G. PATTERSON, Addington, Okla. The invention is especially adapted for use in machines for extraction of Johnson grass, which propagates by means of seed roots, which make a very rapid growth forming a mat in the soil so that it becomes impossible to cultivate any crop therein.

HYGROMETER FOR INCUBATORS.—G. H. LEE, Omaha, Neb. More particularly the invention relates to hygrometers known as "wet bulb" hygrometers, and it provides means for holding the evaporating fluid around the bulb. The invention also resides in the scale of the barometer which especially adapts it for use in an incubator.

STRAW AND MANURE SPREADER.—W. G. DETWILER and J. E. FIREBAUGH, St. John, Kan. The principal objects here are to provide a mechanism for distributing the materials being handled, by power applied through the carrying wheels of the vehicles; to provide means for feeding the material being handled, to the distributing members; and to provide an operating construction free in operation.

Of General Interest.

MAIL-BOX AND LETTER-CARRIER'S POUCH.—L. VIEZZI, Jersey City, N. J. The box and the pouch are adapted to be connected with each other at their closed bottoms, which latter are then capable of opening into the pouch, to allow the contents of the box to drop into the pouch, the latter on being disconnected from the mail box causing an automatic closing and locking of the bottoms of the box and pouch.

LOCKING DEVICE FOR UMBRELLAS AND THE LIKE.—W. L. SPERRING and G. R. PRIDE, Jacksonville, Fla. Means provide for locking the runner sleeve and attached stretcher rods of an umbrella or parasol in closed adjustment on the umbrella stick, the means embodying a locking slide bar and a permutation lock mounted on the stick, comprising a plurality of cup-shaped rings having indicating characters thereon, the rings by adjustment controlling the sliding movement of the slide bar for locking or releasing the runner sleeve.

AUTOMATIC PIANO.—H. MEYER, New York, N. Y. The aim of this inventor is to provide a new and improved automatic piano having a simple and effective connection between the pneumatic and the keys for playing the piano automatically and for allowing playing the keys by hand.

REMOVABLE CALK.—G. S. MEYER, Newburgh, N. Y. The principal object of the present invention is to connect the calks which extend transversely of the under side of the shoe more firmly to the outer member which encircles the hoof, and to provide for the relative movement of the opposite halves of both the inner and outer connecting members.

REMOVABLE CALK FOR HORSESHOES.—G. S. MEYER, Newburgh, N. Y. The object of the present invention is to provide means for effectively holding the calks in engagement with the shoe without the necessity for a separate member extending along the inner edge of the shoe, as is employed in Mr. Meyer's prior constructions.

HORSESHOE CALK.—G. S. MEYER, Newburgh, N. Y. In the present patent the object of the inventor is to simplify the calk and reduce the cost of manufacture by forming not only the calk but the part for securing the same in place, all out of a single piece of sheet metal bent to the desired form.

REMOVABLE HORSESHOE-CALK.—G. S. MEYER, Newburgh, N. Y. This invention has reference to improvements in removable horseshoe calks, and more particularly to a special form of construction whereby the calks are held in place in respect to the shoe, but all danger of the calk-bearing members being torn off by interference is avoided.

PILE-PROTECTOR.—C. N. HUBBARD, Kamela, Ore. In this case the invention has for its purpose the provision of a suitable device for automatically applying the preservative along the length of the pile by the aid of the rise and fall of the water level, thus in tide water giving the pile four applications of the solutions daily.

ORE WASHER AND CONCENTRATOR.—A. DIEU, Medellin, Colombia. The apparatus comprises two troughs or basins one above the other, the upper one being spring supported and having an outlet for the concentrates at the center of the bottom through which the concentrates are delivered to a second trough with a quantity of water added and retreated. The bottom outlet for the first basin is automatically regulated by the weight of the material in the upper trough.

COMBINATION CENTER-SQUARE.—P. H. ALLISON, Torrington, Conn. In this instance the improvement refers to measuring instruments, and the object is to provide a new and improved combination center square, more especially designed for accurately determining the center of round work, for laying out angles and for use as a T-square, depth gage and scale.

DOOR CHECK AND CLOSER.—O. ANSCHÜTZ, 115 Schanzenstrasse, Hamburg, Germany. The invention pertains to liquid door checks and closers, and the object is to provide means whereby the beginning, middle, and end speed of the door can be regulated. When the door is opened a piston is moved by rotary movement of a crank plate, which is turned by means of the usual lever arm on the free end of a spindle, and the spiral spring is thereby wound up.

VALVE.—W. I. BELL, Jersey City, N. J. This valve has a stationary valve seat and a valve member resting against the same, this member being revoluble step by step always in the same direction so as to leave the parts alternately open and closed; one movement of the valve opening all of the parts and the next successive movement of the valve closing them, the next opening them again, and the next closing them again.

Hardware.

LOCK AND FASTENER.—J. ROBERTSON, Perth, Ontario, Canada. The lock includes novel locking devices, and a unique controlling means for the locking devices including a bar which is arranged to slide in the lock and extends into the knobs. The sliding bar is accessible to a person grasping either knob so as to be shifted to prevent turning of the knobs in opening the door. Provision is made for disposing the parts of the locking devices to convert the lock into a night latch.

LOCK.—A. LEONARD, Ashland, Wis. The lock is such as used on doors, windows, drawers, etc. The aim is to produce a lock which can be operated without a key. It is specifically a combination lock, and in its construction it comprises a number of pins or plungers, which must be placed in a certain position before the lock can be opened.

FASTENER.—K. GREEN, Yazoo City, Miss. The improvement relates to fasteners, and more particularly to such as are adapted to be used with traces or the like, and each of which consists of a hook having spring controlled locking means for engaging the nose thereof and movable in a plurality of directions.

THREAD-CUTTING DIE.—L. CASTRACANE, New York, N. Y. More particularly the improvement relates to that type of die in which each die proper is provided with a plurality of cutting faces, whereby the die may be adjusted to different positions to present different faces, and be used in cutting the threads on screws or bolts of different diameter.

DRAWER-PULL.—C. B. ADAMS, New Orleans, La. The invention is an improvement in bolts designed for use on drawer pulls and the like although it is capable of use in other cases where bolts are put through wood or other elastic material. The bolt is adaptable to different thicknesses of board within wide limits without affecting the finish at both the inner and outer faces of the board to which the bolt may be applied.

Heating and Lighting.

MINER'S LAMP.—A. M. VAN LIEW, Houghton, Mich. The object here is to provide a light-weight miner's lamp, which is compact in form, which is adapted to burn wax or the like as an illuminant, in which the combustion of the wax or other substance is complete, and which thus obviates the production of smoke and other noxious gases.

GAS-SCRUBBING APPARATUS.—J. J. NIX, Los Angeles, Cal. The gas is cooled and passes into a scrubber and through compartments to wash the gas. A water seal for a pipe retards the gas on its travel to the retort and the duct, and is thus fixed, and a uniform temperature avoids local, intense and destructive heat. Successive sprays of water in the scrubber washes the gas and the latter passes by way of a pipe to the holder or to the engine or other machine.

Household Utilities.

DRAIN-VALVE.—H. M. KIRBY, Wilmington, Del. The object here is to produce a valve having means for normally holding the valve wide open, the valve having such a construction as will enable the valve to be locked by a simple movement, in its closed position. The valve is especially adapted for use in connection with bath tubs, wash bowls and the like.

DISPENSING-RECEPTACLE.—K. C. JOPLING, Memphis, Tenn. More particularly this improvement relates to a receptacle for tooth powder, which has means for dispensing the powder at will from the container, and which is provided with a chamber adapted to receive the end of the tooth brush so that the powder can be dispensed directly upon the bristles.

BOOK-REST.—D. DUFF, New York, N. Y. The invention provides a rest for use on tables, desks and other supports. It is simple and durable in construction, cheap to manufacture, attractive in appearance, and arranged to permit convenient and quick extension or contraction according to the books to be accommodated at the time, and to securely hold the books in position..

Machines and Mechanical Devices.

DESICCATING AND PULVERIZING APPARATUS.—V. W. MASON, JR., and G. I. ROCHELLE, New York, N. Y. The invention is designed especially for pulverizing the solid constituents of milk in converting milk into a powder or flour. The primary object is to take the pasty substance and convert it into a powder by a single operation, instead of first drying the material and then pulverizing it.

ADDING AND NUMBER-LISTING MACHINE.—B. HOSKINS, Seattle, Wash. This machine may be operated to add columns of figures, and will print a list of items added, and also the totals of the different columns. Such machines are used extensively in banks, counting houses, and similar institutions. The invention constitutes an improvement on the machine formerly patented by Mr. Hoskins.

BELT-TIGHTENER.—G. L. WALLACE, Bridgeport, Conn., and R. Dow, Mansfield, Ohio. The tightener is designed more especially for use on polishing, buffing and like machines, having the driving belt arranged within the column or hollow stand of the machine, the arrangement being such that the tightening pulley is located within the column and the actuating and setting device for the pulley is arranged outside of the column convenient to the operator, to enable him to tighten the belt more or less.

DRIVING MECHANISM.—N. SMELANSKY, New York, N. Y. In its preferred form the invention consists, in combination with a driving shaft, of a pulley journaled on the shaft having an extended hub portion, opposed bevel gears, one journaled on the shaft, the other on the hub portion of the pulley, an idle bevel gear intermeshing with opposed bevel gears, and clutches for respectively connecting the gears to parts on which they are journaled, and the pulley to the shaft.

STAMP-MILL.—O. C. PURKEYPILE, Ashland, Ore. The object of the inventor is to provide means for driving the stamps or hammers in such a way that they will rotate as they strike, in this way producing a desirable grinding action which brings about a very fine reduction and uniform grinding of the ore treated.

UNIVERSAL JOINT.—D. CORCORAN, Yonkers, N. Y. The joint consists of a disk having a semi-circular flange on each of its sides, the planes of the flanges being substantially at right angles to the disk and to each other, and two shafts in one of the terminals of each of which there is a semicircular slot, each of the flanges being disposed in one of the slots, there being curved slots on each flange and a pin disposed on each of the shafts through the slots respectively.

ELEVATOR.—D. CORCORAN, Yonkers, N. Y. The cage has a conical disk with spiral threads on its face, there being a series of studs in the elevator shaft on which are disposed rollers respectively, the threads meshing with the latter. The disk is secured to a shaft on the cage connected by a universal joint to a horizontal shaft having a driving pulley, an idler pulley being disposed thereover. A pulley is at the top and bottom of the shaft, a motor coupled to the latter and the former journaled in a box. The box lowers when the cage reaches predetermined elevations, and means provide for raising or lowering the cage independently of outside power.

THREAD AND TAPE HOLDER.—G. W. WEISS, New York, N. Y. The invention provides an attachment which may be secured to the sewing machine table or top, or any other table or factory table space, and which will serve for support of a plurality of spools of thread and a plurality of rolls of tape, ribbon, seam-binding, or other similar material, which it is desired to sew to the article or garment, and these spools and rolls are locked against displacement so that the employee cannot misplace or intentionally carry away a partly-used spool or roll.

Prime Movers and Their Accessories.

ADJUSTABLE CRANK FOR INTERNAL-COMBUSTION ENGINES.—C. J. GOTTI, Tuckahoe, N. Y. In the present patent the object of the inventor is to provide an adjustable crank for an internal combustion engine, whereby the length of the stroke of the piston in the cylinder can be changed to vary the degree of compression of the charge.

Railways and Their Accessories.

DOOR.—C. W. WHITMAN, Watervliet, N. Y. This improvement in doors is especially designed to be used in connection with street railway cars, and has for its purpose to automatically register the number of passengers entering, and which will permit of the exit without operating the registering mechanism. The movements of the motorman on the platform will not be more restricted than when the usual type of door is employed.

LOG AND LUMBER CAR.—M. M. RUSSELL, Eau Claire, Wis. This inventor has devised and put in successful practical use an improvement comprising a novel stake socket attached to bunks formed of parallel bars, preferably of railroad rails, and provided with a double chain attachment adapted to hold a stake firmly, and safely for the operator.

Pertaining to Recreation.

AMUSEMENT DEVICE.—B. HESS, New York, N. Y. Generally speaking, the invention consists in a series of sinuous undulating tracks connected to an undulating surface, and which are adapted to receive a carriage which travels thereon, the carriage being adapted to carry an occupant whose feet rest on suitable supporting rollers which travel on the undulating surface.

SELF-SPINNING TOP.—O. E. FREAR, Albany, N. Y. The object of the inventor is to produce a top having means whereby the top may be set to spinning without using the ordinary means for this purpose. The device comprises a holder for the top, having a resilient member which is adapted to be engaged by the top, and which may be twisted so that in releasing the top it will exert a spinning force.

Pertaining to Vehicles.

END-GATE FOR WAGONS.—B. M. WILHITE, Gordon, Neb. The feature here consists in the employment of angle iron reinforcing bands. The bands are in pairs, and bent so as to fit closely upon the exterior surface of the end gate plate and the wings thereon. Three pairs of angle iron bands are provided and fixed in place upon the end gate and wings by rivets or bolts, one pair being located at the lower edge of the end gate and its wings, another at their upper edges, and the third pair midway between the other pairs.

SLEIGH-KNEE.—H. WESLE and H WESLE, Medford, Wis. An object here is to provide means for movably attaching the clamp to the sleigh knee proper. Another is to improve the means of fastening the sleigh knee to the runner. It is an improvement on the construction shown in a former patent granted to Messrs. Wesle.

WIND-SHIELD.—J. H. SPRAGUE, Norwalk, Ohio. This invention relates to improvements in wind shields for use on vehicles, and more particularly to that type of shield which is formed of a lower stationary section and an upper movable section. It involves an improved form of supporting means for holding the two sections in any desired position in respect to each other.

SPEED-INDICATOR.—C. KNOPF, New York, N. Y. An object of the invention is to provide tension means for controlling the movements of the ball governor, said means including two separate springs, one end of the springs operating while the indicator is rotated at slow speed, while both springs come into play when speed increases beyond a predetermined limit, and in connection with the springs means are provided for adjusting the tension of the springs at will.

SLEIGH-RUNNER FOR VEHICLE-WHEELS.—J. KARSSEN, Holland, Mich. This invention refers to runners adapted to be detachably fastened to the wheels of a vehicle. It is an improvement on a former patent granted to Mr. Karssen. The improvement which it designs to make is to render the attachment of the runner to the wheel adjustable, so as to fit wheels of various diameters and having various numbers of spokes.

LEAF-SPRING.—W. J. HARRISON, West Derby, Vt. The spring is particularly adapted to motor vehicles, and is designed to arrest the rebound which the conventional spring ordinarily gives when the vehicle is in motion. This is accomplished by providing the vehicle frame with spring hangers and a spring contractable in length under the weight of the load, having its opposite ends connected to the hangers.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12124) N. R. S. asks: Will you be good enough to supply me the following information? I wish to have some information as to reinforced concrete construction. One of my friends writes me a letter whose substance in asking the information is as follows: "My attention has been lately drawn to reinforced concrete construction. This method of construction is, I believe, largely adopted in America, and also to some extent in England and France. I am inclined to give it a trial, and construct one of my buildings entirely on that principle. I have, however, just heard that this construction is likely to collapse after a few years, owing to the corrosion of the metal which is imbedded in the concrete in order to strengthen and support the construction. Will you get me some information on this subject which may tend to definitely dispel or confirm my doubts?" I shall be much obliged if you will send some information on the above subject, or direct me to any other reliable and authentic source. A. We can, if you desire it, give you references to articles in our paper or books on the subject confirming our opinion, but without waiting to look these up we can assure you that your friend is entirely mistaken in the supposition that metal reinforcement in concrete is corroded by any action of the cement. Neat Portland cement, even in thin layers, is an effective preventive of rust. Tools have been taken out of concrete known to have been under water for four hundred years, as bright as when new. Iron rods have been partly imbedded in some experimental blocks of concrete exposed to sea air, and after the external part of the iron had entirely rusted away the imbedded part had not appreciably lost weight. Concrete to be effective in preventing rust, however, must be dense and without cracks, failures in reinforced concrete or corrosion of the inclosed metal being almost invariably traceable to bad workmanship. The concrete should be liquid enough to be tamped closely around the iron, and this is especially important in cinder concrete on account of the moisture absorbed by the cinders.

(12125) P. G. asks: Will you please explain the following questions? I was in New York city some time ago, and while there I visited Coney Island. I saw a show at Luna Park, representing the fight between the "Monitor" and "Merrimac" in Hampton Roads, Va. The question is this: What gives the stereoscopic effect? When I moved my head sidewise, it had the vision of distance. Of course, the picture was on a curtain. Where was the machine located that projected the (moving) picture? There was no shadow of the curtain. Also, please, a description of those long red tubular lights in the post office in New York city (not the Copper-Hewitt vapor lamp). A. Without further knowledge of the picture exhibit to which you refer, we can only suppose that the stereoscopic effect mentioned is caused by the sidewise position of the head, either shutting off the sight of one eye or in so far straining it that the sense of distance of the screen is lost, the unconscious mental calculation by which distance is judged requiring the equal use of both eyes. We know of no mechanical attachment to a kinematograph or bioscope for producing the effect. The lantern may have been at the back of the screen, and the latter wet. The red lights in the New York post office to which you refer are Moore lamps, similar in principle to the Cooper-Hewitt mercury vapor lamp, i. e., the light being caused by the vibrations set up in the passage of an electric current through a partial vacuum containing a residue of rarefied gas. The gas in the Moore lamp is a secret mixture, probably containing mercury vapor and something else.

(12126) E. L. B. asks: Please state in Notes and Queries the reason limestone is used in smelting iron ore. A. Limestone is added to iron ore in the blast furnace because it is the most readily obtainable and cheapest flux. Iron ore consists generally of iron oxide mixed with a gangue or earthy matter which is most commonly silicious. The silica is infusible by itself, but in contact with iron oxide at a high temperature combines readily into silicate of iron, forming slag. To prevent the great waste of iron which would result from the combination of the gangue with the metal of the ore, it is necessary to provide a material with which the silica will readily unite, forming a fusible slag, substances thus added to take up the gangue of the ore and other impurities being known as fluxes. Silica being acid requires a base such as lime, and the slag formed is silicate of lime. The use of fluxes constitutes one of the most important improvements ever introduced into the manufacture of iron, making it possible to reduce the metal from enormous quantities of lean ore containing as little as 25 per cent of metallic iron, whereas it was formerly unprofitable to treat ores containing much less than 70 per cent.

NEW BOOKS, ETC.

The Life of the Universe as Conceived by Man from the Earliest Ages to the Present Time. By Svante Arrhenius. Translated by Dr. H. Borns. Illustrated. Two volumes. London and New York: Harper & Co., 1909. 16mo. Price, 75 cents.

The original title of this work reads in German "Die Vorstellung vom Weltgebäude im Wandel der Zeiten," from which it would seem that "Life of the Universe" hardly covers the subject matter, an impression which is furthermore borne out when it is considered that Arrhenius in this work is concerned not so much with the possibility of life on other worlds, but rather with the evolution of cosmical ideas. Dr. Borns's translation (probably made from the German of Bamberger, and not from the original Swedish) is not what might be termed idiomatic. Many a Teutonism creeps in, but on the whole he has given a very faithful English rendering. This latest excursion of Arrhenius's into the field of astronomy is practically without a counterpart in astronomical literature. The histories of astronomy written by Delambre and by Berry are chronologies with critical comments rather than attempts at explaining the evolution of modern astronomical conceptions. Arrhenius traces the evolution of astronomical thought from the cosmogony of primitive races through the creation myths of the ancients, the philosophic systems of antiquity, and the more scientific speculations of Copernicus and Kepler, until he arrives at the Laplacean nebular hypothesis and its modifications. If there is any truth in Haeckel's dictum that a true understanding of a science can be acquired only by a study of its evolution, then Arrhenius's book may be regarded as one of the most admirable astronomies ever written.

Hydroelectric Developments and Engineering. A Practical and Theoretical Treatise on the Development, Design, Construction, Equipment, and Operation of Hydroelectric Transmission Plants. By Frank Koester, Consulting Engineer, Assoc. Mem. Am. Inst. E. E., Member Society German Engineers (Berlin). With 500 illustrations. New York: D. Van Nostrand Company. 4to.; pp. 454. Price, $5 net.

In writing this volume it was the author's intention to present a comprehensive survey of the most advanced European and American practice in hydraulic engineering. In furtherance of that end he has given an admirable discussion of air shafts and equalizing chambers in connection with pressure tunnels; seamless-welded, flangeless, telescoping penstocks to facilitate shipment and to eliminate expansion joints; siphon systems; impulse wheels with draft tubes and movable water-saving nozzles; compound turbines on a single shaft, the discharge of one being the supply of the other; rapid and complete turbine tests; thirty-thousand-volt generators and efficient devices for protecting them against lightning; novel combinations of single and three-phase generators; wagon-panel switchboard systems; segregation and decentralization of switchboards; continuous water-flow grounders and horn gaps with micrometric setting; and two-legged transmission towers and line-crossing protection. Inasmuch as it is not the object of the engineer as a designer of hydroelectric developments to design any particular machine, such as a turbine, generator, transformer, and the like, but to provide by selection, from the different makes, an assemblage of machines and devices, each designed to perform its particular function in the most economical manner, this volume may be regarded as a handbook which will enable him to have machines properly combined for the purpose of generating and transmitting electric current from water power on a satisfactory commercial basis.

As Others See Us. By John Graham Brooks. New York: The Macmillan Company, 1909. 8vo.; 13 ill. Price, cloth, $1.75.

There are few of us who can fail to profit by a perusal of this "study of progress"—such is the author's secondary title. The author explains that he began the study by chancing, while on a journey, upon a century-old volume of the criticisms of America by an early traveler, which with all its limitations and errors, so much relieved the monotony of his own travels by observation of change and development since the days of the critic, that he determined to let some foreign critic be his guide on all his later journeys. The result is a painstaking comparison of practically all that has been written of America by visitors from abroad, and the extent to which they consider us worth recording may be judged from the excellent bibliography at the end of the book, comprising some hundred volumes. Nothing could be more admirable than the persistent good-nature with which the author refuses to be annoyed by the occasionally insulting comments of foreign visitors when their observations are based on ignorance or prejudice, except his candid sincerity in refusing to accept from them exorbitant praise when superficial or unmerited. The light of after events also shows many a foreign critic once vituperated as spiteful or prejudiced to have been just and impartial. The author's style is lucid and dignified, and in spite of the fragmentary nature of the subject, the book has more sustained interest than many a work of fiction with a continuous story.

Ocean and Inland Water Transportation. By Emory R. Johnson, Ph.D. New York: D. Appleton & Co., 1909. 12mo.; 395 pp. Price, $1.50 net.

Some months ago it gave us great pleasure to review Dr. Johnson's "American Railroad Transportation," a most fascinating and authoritative book, which we enjoyed reading from cover to cover. When the attention of the whole country is devoted to water transportation, particularly inland waters, any book which deals with such transportation is of great interest. It therefore gives us great pleasure to make a brief mention of Dr. Johnson's later volume, which is no less complete in itself than the work relating to railroads. It is a practical and exhaustive treatise on ocean and inland water as a means of transportation, its physical and economic limits, cost, tonnage, and location. The book contains interesting illustrations and valuable statistics, which gives the reader exactly the information for which he is searching. The book is a most readable one, and is an authoritative work on the subject.

India, Its Life and Thought. By Dr. I. P. Jones. New York: The Macmillan Company, 1909. 8vo.; 375 pp.; fully illustrated with photographs. Price, $2.50.

While the present unrest and political ferment in India are so much before the public the present work has an especial interest. The author's point of view is singularly sympathetic and unprejudiced, and while his book has no deliberate political aim and attempts to solve no vexed questions, it sheds a great deal of light upon the complexity of the problem of British government in India. Dr. Jones's experience of India has been that of a Christian missionary and, since his attitude is affected by that capacity, his feeling treatment of his subject is remarkably free from religious prejudice. The book is as attractive to the dilettante mental traveler as it is valuable to the ethnological or political student, and is yet adaptable to summer reading, being as interesting wherever "dipped into" as to the continuous reader. It is admirably illustrated with fine photographs, the subjects including, of course, the peerless Taj Mahal and many other less known but little less beautiful gems of Oriental art.

The Engineering Index for 1908. Compiled and published by the Engineering Magazine. New York: 1909. 437 pp.; large 8vo. Cloth, $2.

The present volume entirely lives up to the reputation of its predecessors as being the most complete, if not the only, index of all engineering literature, whether included in books, technical periodicals, or the journals and proceedings of the engineering societies. This latest volume brings the investigator down to the close of 1908, while the earlier parts enable searches such as occur in patent cases and the like to be prosecuted with a minimum of cost and delay. In this book, as in the volume issued last year, the "classified" system of arranging the items is followed in place of the "strict alphabetic" order of the earlier volumes. In other words, the articles indexed are first grouped under the great divisions of engineering practice to which they belong—Civil, Mechanical, Electrical, Mining, etc.—and under these again they are sub-grouped according to the recognized special divisions of each field. This is possibly one of the greatest services the index renders to its regular users. The monthly continuation of the index, from the close of 1908, is to be found in the successive issues of the Engineering Magazine.

The Proper Distribution of Expense Burden. By A. Hamilton Church. New York: The Engineering Magazine, 1908. 16mo.; 116 pp. Price, $1.

The contents of this book, prepared originally for The Engineering Magazine, is a series of articles which at once took rank as a standard reference work on one of the most difficult questions of cost finding. A constant demand for these numbers has led to the republishing of the entire group in book form. An accurate distribution of general expense is admittedly one of the most perplexing and yet one of the most important problems with which the manufacturer must deal. The simple yet thorough analyses conducted in this volume, and the clear, common sense demonstration presented, will furnish a reliable guide to the solution of highly complex conditions in factory economy. The book is a most excellent one for all who are engaged in manufacturing.

The Copper Handbook. Eighth annual edition. By Horace J. Stevens. Houghton, Mich.: Published by the compiler, 1909. 8vo.; 1,500 pp.; cloth. Price, $5.

This number of the now widely known annual, which circulates in every country that has postage, more than lives up to the reputation established by its predecessors. Whereas the Copper Handbook is principally known as a complete directory of the copper mines of the world—their offices and officers, directors and staff, works and plant, with concise but complete descriptions of the history, geography, and operations of each mine—it contains a great deal of more general interest. Even in the principal chapter of 1,185 pages describing no less than 6,767 mines there is much interesting reading even to the layman, the descriptions of Calumet and Hecla or Anaconda, for instance, being full of the romance of great industrial achievements and the conquest by American skill and enterprise of the fastnesses of nature. The book includes a glossary of mining terms and concludes with the most complete statistics of the industry, world's production of copper by countries and states, output of leading mines, variation of prices, share-holding and dividends of companies, etc. The compiler shows his confidence in the value of his work by sending it anywhere, charges prepaid, allowing a week's inspection and return of the book if not found acceptable.

How to Appreciate Prints. By Frank Weitenkampf. New York: Moffat Yard & Co., 1908. 12mo.; 338 pp. Price, $1.50 net.

Mr. Weitenkampf is the curator of the print department of the New York Public Library, and there is no better connoisseur in the world than he. His knowledge of prints and kindred material is at the disposal of all who are in any way interested in the subject. The Lenox Library, where the prints are kept at the present time, is a Mecca for students, who are directed to the proper source of material by Mr. Weitenkampf. This qualifies him to produce a very valuable treatise, which it gives us great pleasure to review. The first chapter deals with "The Taste for Prints"; then comes a chapter on "Etchings"; then one on "Line Engraving"; "Mezzo-tints"; "Tint Methods"; "Stipple and Other 'Dot' Methods"; "Wood Engraving"; "Lithography"; "The Photo-mechanical Process"; "Color Prints"; "Coloring"; "The Making of Prints"; and "Certain Minor Information." The book is admirably written and shows a broad and catholic appreciation of the entire subject. We have not seen such a good book on prints for many years. We congratulate Mr. Weitenkampf on the production of such an excellent book.

Electric Railway Power Stations. By C. F. Swingle. Chicago: F. J. Drake & Co., 1909. 8vo.; 720 pp.; fully illustrated with photos and diagrams. Price, $2.50.

In this work the author attempts to include all that it is necessary for a central station engineer to know about boilers, mechanical stokers, steam engines, both turbine and reciprocating, gas engines of all kinds, pumps and auxiliaries of all kinds, dynamos, motors and switchboard instruments of every description. If this ambition were attained with complete success the book could hardly be so portable. It is possible that there may be central stations which include both gas engines, reciprocating steam engines and turbines, and operating engineers who desire all those machines described in one book, but we should say that any engineer who did not know as much of the contents of this book as applied to his particular work would prefer to learn it from separate books on the different subjects with space enough to treat them thoroughly. Questions and answers are interspersed through the book with no particular reference to the text, an examination on slide-valve setting appearing, for instance, at the end of a chapter on steam turbines. The illustrations are apparently taken principally from manufacturers' catalogues, and being photographs of half-tones does not add to their clearness. As a whole, at a time when more than ever it may be said that "of the making of many books there is no end," this work appears to us to fall naturally into the harmless but unnecessary class.

Hints on House Furnishing. By W. Shaw Sparrow. New York: John Lane Company, 1909. 8vo.; 308 pp. Price, $3 net.

The sumptuous volume before us is filled with valuable hints on house furnishing and decoration. The plates are particularly well executed and are inserted, allowing the text to be printed on paper which is agreeable to the eye and to the fingers as well. After a general introduction which covers the subject in an admirable manner, the walls and their treatment are taken up, followed by the floors and their treatment; then come the ceiling, the windows, blinds, and curtains. A chapter on textile fabrics follows, and there is an interesting chapter on artificial heat and light. Then the furnishings of the house are treated. Crockery and porcelain are treated in the next chapter, and then comes a chapter on furniture and sanitary appliances. There are also chapters which give valuable hints on rooms for various uses. There is even a section on that much-neglected subject—garden furniture. It is a beautiful book which is worthy of a large sale.

The Autobiography of Nathaniel Southgate Shaler. With a Supplementary Memoir by His Wife. With illustrations. Boston and New York: The Houghton Mifflin Company, 1909. 8vo.; pp. 481. Price, $4.

In the annals of Harvard University it would be difficult, indeed, to find a man who exerted so far reaching an influence upon the student body at large, as well as upon those members of the faculty with whom he came into more

or less intimate contact, as the late Prof. Shaler. Memorable as his wonderful personality undoubtedly was, the great public is probably more interested in his scientific attainments as a geologist. His special studies of oceanic shore lines, volcanoes, glaciology, and lunar geology are probably the works upon which his scientific reputation is most firmly seated. It is unnecessary for us to dwell upon that work here, largely because its merit was recognized in his lifetime. The autobiography before us is a charmingly written, unaffected statement of a career carefully molded from childhood, and replete with incidents that have not a little human value, inasmuch as Prof. Shaler during his long life met most of the celebrities who have ever reached Cambridge and Boston, and noted his impressions of them. The autobiography is a record of lifelong efforts to interpret the facts and mysteries of nature upon which Prof. Shaler so lovingly pondered.

COOKING FOR Two. By Jeanette M. Hill. Boston: Little, Brown & Co., 1909. 12mo.; 407 pp. Price, $1.50 net.

This is a handbook for young housekeepers, and is designed to give cheaply and simply and in concise form those things which are essential for the proper selection and proportion of a reasonable variety of food for a family of two. Of course, by doubling the quantity of each ingredient, enough can be prepared for four or five people. The food products considered in the receipts are such as a housekeeper of average means would use on every-day occasions, with a general sprinkling of choicer articles for Sunday. Menus for a week or two in each month are given. The receipts are given with special attention to clearness of expression. The illustrations are particularly valuable. In many cases they show the *modus operandi* and proportions, or else the raw materials and the various steps. The half-tones are beautifully executed and they are well printed. We have not seen any cook-book for a long time which compares favorably with this one.

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PATENTS

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INDEX OF INVENTIONS

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File and similar abrading tool, T. Boswell 934,882
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Horses' feet, composition for removing corns from, Fulton & Bergeron 934,515
Horse releaser, P. Thielen 934,476
Horsetail band, H. C. Unger 934,638
Horsetail holder, M. R. Jones 934,969
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Car coupling, L. Thamas 935,563
Car door, W. T. Anfield 935,450
Car door lock, freight, W. C. Kneale 935,526
Car door operating mechanism, railway, S. Otis 935,050
Car fender, C. Arnesen 935,574
Car seat, H. Witte 935,242
Car step, Tischler & Henklein 935,098
Car, tank, C. A. Lindstrom 935,210
Carpenter tool, O. A. Kolstad 935,308
Carpet sweeper and cleaner, J. M. Spangler 935,558, 935,559
Carriage top support, E. Jordalen 935,369
Cartridge shells, means for feeding, H. D. Hodge 935,367
Cash register, T. Carroll 934,994
Caster, adjustable, J. M. Wood 935,289
Cement, bituminous, J. H. Amies 935,573
Cement, manufacturing, M. Trembour 935,617
Cement product and making same, vitrified, Todd & Mayr 935,616
Chair, O. S. Jennings 935,306
Chair, I. Mason 935,385
Chimney cap, T. Martin 935,213
Chopping knife, S. L. Bates 935,576
Churn, C. M. Long 935,377
Cigarette box, S. A. Spaziante 935,064
Cipher systems, apparatus for use in connection with check, Newton & Michell 935,536
Circuit controlling mechanism, M. W. Day 935,092
Clamp, J. F. Lawrence 935,527
Clutch for transom rods, N. G. Pilcher 935,245
Coal hod, A. T. Robinson 935,409
Coaster brake, P. P. O'Hora, reissue 13,023
Cock, ball, E. S. Stack 935,281
Coffee mill, M. Holl 935,153
Coking process, L. L. Summers 935,175
Commutator, W. A. Dick 935,300
Compass, L. Harris 935,497
Composing machine, galley mechanism for typographical, Pearce & Billington 935,543
Concentrator and classifier, centrifugal, F. Laist 935,311
Condenser, E. N. Woodruff 935,446
Cooler. See Water cooler.
Coop or crate, folding, F. T. Wing 935,443
Corn harvester, E. F. Swanson 935,562
Cotton choppers, caster wheel for, J. W. Garrett 935,598
Cotton grader, L. A. Greene 935,149
Cotton picker, D. M. Bailey 935,185
Cotton press, F. E. Thomas 935,432
Coupling, A. H. Harris 935,624
Crank, variable throw, G. R. Grout 935,495
Cream separator, G. N. Wolf 935,183
Culinary utensil, D. H. Coles 935,189
Cultivator, E. B. Fitzgerald 935,008
Cultivator, C. Gardner 935,487, 935,488
Cultivator, Benton & Jordan 935,578
Cultivator, disk, W. L. Clevenger 935,297
Culvert mold, Fife & Coleman 935,097
Current motor, alternating, A. C. & T. R. Bell 935,352
Curtain rod fixture, L. K. Brigham 935,357
Cuspidor, railway, W. Hill 935,508
Cutter guard, P. Foster 935,481
Damper regulator, Mitchell & Brawley 935,390
Davit lock, Ryan & Tanning 935,413
Dental and like instruments, rack or tray for, W. L. Smith 935,420
Dental and like tools, rock for, W. L. Smith 935,413
Die and die support, W. D. Coolidge 935,463
Dish washing device, M. Froese 935,146
Dispensing machine, P. C. Petersen 935,401
Display or show case, W. Freeman 935,100
Displaying apparatus, sample, G. E. Fariss 935,302
Ditching and grading machine, W. I. Short 935,240
Door opening apparatus, automatic, L. Effenberger 935,475
Door operating means, Rogers & Vogel 935,410
Door stop, F. M. Mosier 935,392
Draft appliance, W. W. Winger 935,135
Draft equalizer, F. E. Travis 935,434
Draft hook, D. P. Springer 935,423
Draft rigging, machine for testing and registering operation of, J. F. O'Connor 935,162
Draft sill, Acker & Bundy 935,449
Dredgers, excavators, etc., tooth for steam, C. E. Gardner 935,147
Drill holder, A. H. Knight 935,055
Drill support, electromagnetic, G. Doenig 935,291
Drilling machine table, A. Davis 935,470
Drilling machines, material holder for, S. P. French 935,010
Drip pan, M. C. Smyth 935,278
Dry separator, R. R. Snowden 935,421
Duplicating or printing machine, Havens & Page 935,604
Dust collector, G. Saesny 935,066
Dust through the application to roads, or road material of an aqueous emulsion of oil, preventing and laying of, W. M. Saudison, reissue 13,024
Dye, azo, Gunther & Hesse 935,018
Dye, azo, Kahn & Ossenbeck 935,031
Dye, azo, Julius & Fussenegger 935,371
Dye, sulfur, J. Flachslaender 935,090
Dye, vat, J. Delnet 935,500
Dye, yellow, Gunther & Hesse 935,016
Dye, yellow azo, Gunther & Hesse 935,017
Dyes and making them, pyrazolone, Julius & Fussenegger 935,370
Educational device, A. C. Immer 935,258
Egg beater, F. P. Burr 935,688
Electric distribution, J. L. Creveling 934,997
Electric fixtures, outlet box for, Erickson & Bradshaw 935,097
Electric furnace, A. Reynolds 935,548
Electric light flasher, automatic, J. O. Houser 935,207
Electric light hanger, adjustable, L. Buendert 934,992
Electric outlet boxes, hanger for, A. McMurtrie 935,319
Electric shade holder, E. F. Gennert 935,012
Electric switch, J. G. Peterson 935,226
Electrode, storage battery, L. H. Flanders 935,252
Electrodes for electrolytical purposes, making durable carbon, Adolph & Pietzsch 934,988
Elevator, W. T. Long 935,378
Elevator door operating device, C. L. Gruhn 935,107
Elevator gate lock, automatic, E. F. Joyce 935,097
Elevator safety brake, automatic, L. Givulinovich 935,200
End gate, C. Schallau 935,168
End gate, J. H. Harvey 935,498
Engines, device for barring over, C. E. Sargent 935,235
Engines, dynamometer thermo couple for explosion, N. M. Hopkins 935,154
Envelop, safety, B. Z. Nyce 935,270
Explosive compound, F. H. Briggs 934,990
Extension table, E. L. Marston 935,608, 935,609
Fan, rotary, J. Keith 935,114
Fare indicator and register, H. E. Sayer 935,273
Fence, T. W. King 935,522
Fence stretcher, M. E. Johnson 935,030
Fence wire locking device, F. Cummings 934,999
Fertilizer distributer, J. H. Bloom 935,579
Filling and capping apparatus, F. J. Heybach 935,506
Filter, D. W. Field 935,006
Filtering apparatus, D. Diver 935,359
Finishing process, H. L. Haskell 935,603
Fire escape, W. Crane 935,142
Fire escape, M. S. Woods 935,447
Fire extinguishers, sprinkler head for automatic, M. K. Hopkins 935,257
Fire resisting shutter and slat therefor, flexible, E. H. McCloud 935,125
Fire shield, collapsible, J. A. Dennis 935,248
Firearm, A. Fyrberg 935,102
Firearm, A. J. Savage 935,237
Firearm, repeating, G. S. Lewis 935,314
Firearms, recoil pad for, M. B. Parker 935,163
Fish scaling machine, A. Grub 935,502
Floor drain, G. J. Dehn 935,000
Floor scraper, F. M. Israel 935,259
Flooring and ceiling, interlocking, J. W. Piver 935,402
Flue expander, J. P. High 935,366
Flushing cistern for closet bowls, Van Zandt & Thacher 935,341
Flushing tanks, float ball for, T. Zwermann 935,448
Flying machine, A. R. Malasomma 935,039
Flying machine, W. H. Martin 935,384
Fork. See Loading fork.
Form locking and adjusting device, E. I. Manent 935,212
Fruit washer, C. H. Hallauer 935,201
Furnaces and converters, operating blast, J. Gayley 935,628
Fuse for projectiles, safety percussion, D. J. Cartwright 935,188
Game apparatus, F. Dando 935,469
Game apparatus, T. S. Campbell 935,585
Garden implement, W. C. Doidge 935,473
Garment, bifurcated, F. F. Lewis 935,159
Garment fastener, C. H. Schmidt 935,238
Gas and air for illuminating purposes, manufacture of a mixture of, F. W. Wolff 935,444
Gas engine, J. T. Cowie 935,001
Gas generating apparatus, J. H. Stringham 935,283, 935,429
Gas generator, J. S. Loder 935,119
Gas generator, hydrocarbon, E. B. Brown 935,294
Gas, making water, C. E. White 935,344
Gasket, C. I. E. Mastin 935,387
Gate, K. J. Holdeman 935,206
Gate, W. H. Clark 935,588
Gate and door, H. P. Latham 935,374
Gear case, G. W. Bandy 935,351
Gear mechanism, sliding, H. M. Russell, Jr. 935,328
Gear, variable transmission, J. J. Knecht 935,034
Generators to secure constant potential, device for regulating the speed of, A. L. Rohrer 935,051
Glass cutting table, Green & Henry 935,014
Glove, G. C. Fried 935,011
Governor, G. H. Wilson 935,442
Grain bin, A. N. Eaton 935,096
Grain separator, G. E. Arnold 934,989
Graphite article and making same, A. M. Hammon 935,180
Grinding apparatus, tool, G. W. Riddle 935,406
Grubbing implement, L. P. Harvey 935,020
Gun with recoiling barrel, E. Olsson 935,222
Hame clip, W. A. Wilson 935,080
Hammock frame, collapsible or folding, K. L. Hyller 935,513
Hammock supporting frame, M. D. Wolf 935,445
Hand wheel, A. Hallowell 935,019
Harness attachment, P. M. Stevens 935,173
Hat frames, device for forming wire, W. M. Jameson 935,305
Hat ventilating attachment, C. A. H. Smith 935,556
Hatch cover, G. H. Tackman 935,431
Hay rake, M. A. Westbrook 935,179
Headlight attachment, F. J. Pfister 935,228
Heater, T. J. Bartow 935,244
Heaters, injector for hot water, J. W. Gulmont 935,015
Heel, cushion, J. Cairns 935,089
Hinge, A. D. Perkins 935,611
Hinge, cover, C. G. Bloomer, Jr. 935,087
Hinge, segmental, W. Favreau 935,594
Hoe, scuffle, A. S. Knapp 935,116
Hoist, electric, A. A. C. Gese 935,363
Hook and eye, W. Ferris 935,098
Hoop projecting device, C. M. & T. Bartholomew 935,455
Horse checking device, Hobbs & Jewell 935,625
Hose reconstruction, C. M. C. Baird 935,086
Hose coupling, G. A. Anderson 935,082
Hose coupling, instantaneous, W. J. Casey 935,587
Hot water heater, W. H. Kogle 935,117
Hub attaching device, R. G. Roulstone 935,061
Hydrant casing, J. Day 935,471
Hydrant head, irrigating, N. S. Twiford 935,596
Hydrocarbon burner, J. Stubbers 935,430
Hygienic heater, H. L. Stutts 935,561
Ice cream freezer, continuous, H. J. Gerner 935,490
Ice cutting machine, A. J. Offord 935,127
Implement frame, A. G. Dewey 935,144
Incandescent bulbs, capping machine for, T. J. Hetherington 935,503
Incubator, multiple compartment, C. E. Adair 934,986
Insect catcher, H. Strangenbach 935,428
Inverted burner, J. J. Weyer 935,241
Iron or articles cast from iron, reducing the amount of carbon in cast, W. Rubel 935,234
Ironing board, M. L. & G. Bacon 935,184
Jar closure, E. W. Pearce 935,321
Journal bearing, Heron & Deverell 935,022
Key retaining device, Guindon & Tyson 935,623
Kinematograph apparatus, driving mechanism for, C. Rossi 935,167
Lamp, electric arc, A. D. Jones 935,518
Lamp, miner's, O. M. Muller 935,219
Lamp operating mechanism, Warfield & Nicholson 935,437
Lamp suspension device, electric arc, A. Wunderlich 935,136
Lantern head, A. R. Prichard 935,324
Lard gage extractor, T. F. Ray, Jr. 935,404
Lasting machine, F. Chase 935,000
Lathe, G. W. Davis 935,143
Lathe tool holder, J. D. Ramsey 935,547
Lavatory, S. Bedson 935,290
Lavatory, W. Bunting, Jr. 935,621
Lawn sprinkler, W. Wessler 935,071
Lawn trimmer, Person & Uhler 935,225
Leather splitting machine, T. H. Mayo 935,533
Ledger and file, combined, L. A. Blochman 935,353
Level and gage, track, C. C. Lynch 935,038
Lever, hand, R. H. Bowman 935,581
Lifting apparatus, T. M. Smith 935,170
Liquid distributing apparatus, C. Potts 935,231
Liquid meter, Speed & Wright 935,129
Liquids and gases, apparatus for effecting intimate contact of, Hersey & Blake 935,501
Loading and unloading apparatus, B. F. Miller 935,042
Loading fork, R. Pederson 935,544
Lock. See Car door lock.
Lock mechanism, M. Farch 935,004
Locomotive boiler superheater, O. W. Ott 935,224
Locomotive superheater, O. W. Ott 935,223
Looms, thin place detecting means for, H. L. Freeman 935,099
Lubricator, J. Kelly 935,260
Magnesium carbonate, producing, G. Sisson 935,418
Mail bag crane and catcher, J. G. Fleenor, Jr. 935,596
Mail bag delivery apparatus, J. G. Fleenor, Jr. 935,595
Mail bag lock, G. I. Willett 935,287
Mail box coin holder, rural, G. E. Wemhoff 935,076
Mail box collection indicator, W. W. Day 935,191
Mail crane, railway, J. C. Adams 934,987
Manure loader, J. B. Mohan 935,391
Manure receptacle, W. H. Hunt 935,511
Marine table, J. H. Jones 935,155
Match box and cigar cutter, combined, Ross & Ward 935,411
Match box, safety, J. & W. H. Demaine 935,472
Meat skinning machine, J. O. Williar 935,181
Medical irrigator, Pfeifer & Towles 935,227
Merry-go-round, F. A. Dyon 935,003
Metal plates, apparatus for pickling and washing, G. Mesta 935,619
Metal sawing machine, C. Napier 935,395
Metallic compounds, wet method of separating, J. H. Thwaites 935,337
Milk can, jacketed, P. Larsen 935,265
Milking machine, W. J. Uebler 935,358
Milling machine, bevel gear, P. L. Weston 935,077
Milling machine, cycloidal, C. Wiebke 935,345
Mirror stand or support, adjustable, G. P. Humphries 935,208
Miter box, J. A. Leland 935,375
Mop making machine, A. Lackey 935,264
Motors, controlling electric, J. L. Routin 935,327
Music stand, M. F. Dougherty 935,592
Musical device, J. W. Nunn 935,539
Napkin ring and holder, combined, W. L. Barnard 935,454
Nest, trap, J. I. Ault 935,084
Nozzle, spray, P. A. Myers 935,124
Oar blade forming machine, J. P. Tarbox 935,334
Oar blade shaping machine, J. P. Tarbox 935,333
Oar rack, E. G. Hodgkins 935,027
Oil burner, W. A. Mack 935,530
Oil burning furnace, C. A. Hammel 935,202
Oil feed for drills, M. Galowics 935,484
Oilstone holder, Badge & Carle 935,350
Ore screen, Meiklejohn & Villars 935,216
Outlet box, L. H. Church 934,996
Pan cover, frying, L. I. Buehl 934,991
Paper cutting device, C. Van Middlesworth 935,340
Paper making system, H. S. Rinker 935,407
Paper roll bracket, S. Wheeler 935,078
Paper vessel, C. F. Jenkins 935,029
Paper winding device, H. M. Griffin 935,494
Parer, ear corn, M. B. Johnson 935,517
Pay station, automatic, H. W. Hamlin 935,150
Pencil holder, J. W. Myers 935,393
Photographic developer, Kelly & Bentham 935,115
Photographic developer, W. F. C. Kelly 935,156
Pick, Gill & Gates 935,253
Picture, C. W. Saalburg 935,612
Pipe joint, R. R. Rust 935,412
Pipe line shafting, coupling clamp for, J. E. Jones 935,111
Pipe mold, E. J. Mag 935,529
Pipe puller and holder, S. L. Blake 935,186
Pitman connection, Chrysler & Kays 935,140
Planter, H. Smith 935,063
Planter, seed, G. T. Pine 935,546
Plectrum action, J. Rehbock 935,271
Plow, ditching, J. M. Cornelius 935,464
Plow harrow attachment, S. Seltner, Jr. 935,417
Plow standard, W. J. Klein 935,522
Plug attachment, C. J. Klein 935,523
Pneumatic motor, R. A. Norling 935,537
Pocket knife, E. Mallon 935,380
Potato digger, F. Lesser 935,209
Powder ejector, W. W. Sands 935,415
Press. See Baling press.
Print developing and washing apparatus, H. C. Gawler 935,148
Printer and recorder, check, W. H. Baur 935,453
Printing frame, L. D. Gagne 935,486
Printing machines, sheet delivery mechanism for, T. M. North 935,538
Printing plate clamp, flexible, J. White 935,439
Printing press foundation, W. S. Warnock 935,073
Printing press attachment, C. Van Middlesworth 935,339
Printing presses, construction of reciprocating beds for cylinder, M. Rockstroh 935,550
Prismatic and diffusion inclosure, O. A. Mygatt 935,220
Propeller, lifting and driving, R. Strehlau 935,130
Pulverizing machine, W. K. Nix, Jr. 935,161
Rack or holder, Hill & Gray 935,507
Radiator, S. D. Stauffer 935,172
Rafting system, log, N. C. Elfer 935,376
Rail, J. Keeton 935,310
Rail joint, J. F. McGhee 935,394
Rail securing device, guard, G. C. Lucas 935,037
Rail securing device, track, B. Bourne 935,580
Railway frog, H. K. Hitchcock 935,205
Railway signal, C. W. Coleman 934,996
Railway signal, A. C. Mather 935,215
Railway switch, R. P. Kiblinger 935,157
Railway tie, G. W. Wagner 935,133
Railway tie, M. L. Townsend 935,433
Railway tie and cushion, E. H. Johnston 935,307
Railway tie and fastener, A. E. Baker 935,243
Railway trains, safety brake apparatus for, D. M. Daley, et al 935,468
Ratchet brace, J. H. McLaughlin 935,047
Ratchet brace, G. M. D. Heard 935,256
Ratchet brace, J. A. Leland 935,266
Razor, safety, L. Knaster 935,032
Receptacle, metallic, E. R. Williams 935,440
Record holder, W. T. Long 935,379
Reflector, L. Zamboni 935,347
Reflectors or shades and electric lamps, means for use in connection with combined, L. Zamboni 935,348
Refrigerator, window, C. C. Hatcher 935,021
Register securing means, J. J. & S. P. Burgess 935,187
Rein holder and holdback, combined, C. P. Kertell 935,520
Replanter, corn, C. A. Lonnecker 935,528
Ribbon shifting mechanism, C. Spiro 935,280
Rivet, E. B. Stimpson 935,331
Riveting stake, adjustable, O. Siegler, et al 935,555
Rolling tin plates, apparatus for, C. W. Bray 935,356
Roof guard, S. W. Popel 935,055
Roofing and for like uses, means for retaining and supporting metallic plates for, H. C. Ferron 935,479
Rope slide, C. Harrell 935,151
Rotary engine, A. A. McLaren 935,046
Rotary engine, W. W. Wheeler 935,079
Rotary engine, W. H. H. Morelock 935,160
Rotary engine, G. Westinghouse 935,343
Rotary engine, Garrabrant & Burdge 935,489
Rotary steam engine, J. E. Friend 935 101
Rubber, D. Sandmann 935 414
Rubber hose, making, F. J. Gleason 935254
Ruler, parallel, F. W. Sterling 935,424
Sad iron holder, J. M. Harper 935,106
Sad iron holder, H. F. Moulden 935,123
Safety appliance, Howard & Stark 935,605
Sash fastener, H. B. Sutch 935,131
Sash fastener and holder, C. J. Platzer 935,165
Sash fastener, vehicle, E. R. Mitchell 935,389
Saw, drag, S. Feller 935,197
Saw blade sharpener, swaged, W. R. Anthony 935,138
Scale, A. G. Worthington 935,571
Screen, C. J. Jewett 935,516
Screen hanger, J. T. Leonard 935,267
Screen mounting, window, J. F. Beatty 935,577
Screw cutting machine, E. J. Miller 935,315
Screw thread finishing tool, A. T. Crane 935,247
Screw threading devices, work holding means for, L. P. Hart 935,107
Seal and protector for knots, Shapiro & Konow 935,554
Seal lock, O. Edler 935,195
Selective A.C.-D.C. system, G. H. Hill 935,023
Selective A.C.-D.C. system, J. F. Tritle 935,069, 935,070
Self-serving table, F. E. Brunson 934,993
Separator pans, guide for, L. Meyer 935,041
Sewing machine, H. Dreist 935,145
Sewing machine attachment, wax thread, W. J. Brennan 935,020
Shaft hanger, J. A. Esco 935,593
Shearing machine, sheep, S. Abeyta 935,137
Sheet feeding machine, R. L. Hanau 935,496
Sheet metal box packer, R. Richards, et al 935,549
Sheet metal shears, C. D. Wagner 935,072
Shelving, revolving inclosed, J. A. Doxtator 935,249
Sheradizing, plant for, W. C. Robinson 935,058
Shock absorber, W. B. Knapp 935,525
Shock absorbing wheel, G. F. Crass 935,622
Shoe support, M. H. Cazier 935,461
Shoe supporting jack, E. A. Stiggins 935,065
Show case and receptacle cover, combined, C. A. Piepho 935,054
Show or display cases, apparel support for, L. G. Dodge 935,095
Side delivery rake, Blackstone & Watts 935,456
Sifter, F. E. Boyle 935,354, 935,355
Sign, revolving illuminated, J. E. Saunders 935,236
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Silk, treatment of materials containing, Boettger & Vom Eyser 935,292
Silo, D. E. Monta 935,209
Skein holder, F. E. Weightze 935,342
Skewer, Stark & Baxter 935,171
Skip, O. E. Strehlow 935,282
Slag handling table, D. T. Croxton 934,998
Sleigh driving wheel, C. H. C. Hakanson 935,104
Snap hook, A. L. Strohl 935,174
Sodium peroxid, treating, D. E. Parker 935,542
Soils, quicksand, etc., consolidating loose, A. Wolfsholz 935,081
Soldering machine, can can, J. A. Cuthole 935,462
Speedometer, J. H. & E. W. Bullard 935,583
Spring motor, O'Bannon & Field 935,540
Stacker, hay, J. Dain 935,298
Stain indicator, E. Eckart 935,474
Stamping apparatus, K. Hubert 935,509
Steam engine, E. F. Edgar 935,194
Steam trap, C. Stickle 935,426
Steaming tray, food, G. S. Walker 935,177
Steel plates, treating, C. Davis 935,356
Steering mechanism, A. Mauksch 935,610
Stereopticon, dissolving, C. F. Dutton, Jr. 935,193
Stone and stump removing machine, A. Villeneuve 935,132
Stone mold, artificial, T. V. Galassi 935,483

Stove or range top, kitchen, Lauer & Demeter	935,313
Stoves, checker brick for hot blast, D. Lamond	935,372
Straight edge or ruler, L. Lucas	935,120
Street and road building, composition for binding, surfacing, and resurfacing purposes in, J. H. Amies	935,572
Stretcher, Rheubottom & Rayner	935,056
Submarine operations, apparatus for, P. E. Galoffre	935,485
Switch stand, J. T. Farrell	935,005
Switch throwing device, automatic, A. M. Mitchell	935,043
Swivel, J. G. Owen	935,627
Telegraph key, G. S. Perry	935,164
Telegraphy, apparatus for wireless, G. Marconi	935,382, 935,383
Telegraphy, transmitting apparatus for wireless, G. Marconi	935,381
Telegraphy, wireless, W. W. Massie	935,386
Telephone apparatus, coin freed locking device for, H. Janke	935,515
Telephone exchanges, apparatus for facilitating communication between, A. T. M. Thomson	935,285
Telephone exchanges, calling device for, N. E. Norstrom	935,049
Telephone mouthpiece guard, L. H. Webber	935,618
Telephone system and the like, R. Hamilton	935,105
Telephone system, lock out, W. W. Hill	935,024
Telephone transmitters or receivers, antiseptic protector for, F. Schilling	935,274
Thermostat, electric, J. R. Carpenter	935,400
Timber felling and sawing machine, J. W. Smith	935,128
Time recorder, C. E. Ruppee	935,312
Tinware and for the recovery of solder therefrom, method and apparatus for cleansing articles of refuse, J. W. Evans	935,477
Tire, D. W. McLean	935,126
Tire, C. F. Dinkle	935,192
Tire, L. M. Nelson	935,396
Tire, G. W. Sharpe	935,613
Tire protective rivet, E. B. Stimpson	935,332
Tire, vehicle, C. H. Knecht	935,033
Tire, vehicle wheel, H. M. & T. J. Deeth	935,093
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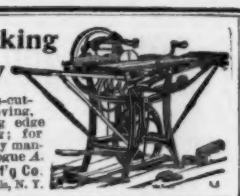

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STEREOSCOPIC MOVING PICTURES IN NATURAL COLORS.

(*Continued from page 256.*)

pictures are taken and projected intermittently, the shutter both in the camera and projector being a sector having an area approximately one-seventh of the area of a circle. While the shutter is closed the film is jerked forward by an interval equal to the height of a single picture on the film. In the Friese-Greene apparatus, however, a continuous picture is secured, since the operation of the twin lenses is alternating, that is to say, while one is closed the other is open. Consequently although the separate films carry images intermittently recorded, the one secures those which the other lost during the short space of time its lens was closed by the shutter.

In regard to the arrangement of the color filter and its manipulation a highly important development has been effected. The color filters are disposed on an endless band of transparent celluloid in the order of red, green, and blue. Each filter is of the same size as the cinematographic image on its film, namely, ¾ inch deep by the standard width, and like the latter is perforated along its edges so that the movement of the color filter and sensitized films are synchronous and the two being kept in dead juxtaposition. By reducing the thickness of the color filter medium to the infinitesimal proportions of a thin celluloid band all troubles concerning light refraction and reflection are completely overcome.

By reference to the accompanying illustration showing the interior of one side of the stereoscopic camera, its operation may be clearly understood, as well as the disposition of the color filter band. Starting from the point *A*, which is a pulley, the color filter band passes to and over the jockey pulley *B*, thence around the drum *C*, where it picks up the unexposed sensitized film issuing from the unexposed-film spool-box at the top on the right, and is superimposed on the sensitized surface of the film. The color filter and film are now caught with their respective edge perforations in dead register, and carried down through a guide channel *D* to the point of exposure behind the lens. As the shutter is closed the oscillating twin pronged arm *E* falls, and the teeth engaging with the perforations of the two superimposed films pulls them down together over the lens for a distance of three-quarters of an inch—the height of a cinematograph picture—and holds them firmly there during exposure. This completed, the turning of the driving handle raises the pronged oscillating arm *E* so that the films are released, and the arm rising in its travel falls and grips the films, once more jerking them down another three-quarters of an inch over the lens aperture. This cycle of operations is repeated while exposures are being made, successive filters and corresponding sections of sensitized film being brought forward in this manner.

As the exposed film surface and its color filter pass away from the lens they travel together over another jockey pulley and drum *F*, after which the two separate, the exposed film passing over the pulley *G* and entering the exposed film box, where it is wound on the spool in the usual manner, while the color filter band travels over the pulley *H* along the base board of the camera under the guide pulley *I*, up the back of the apparatus over pulley *J* and along the top to pulley *A* and *B* to *C* where it picks up the sensitized film once more. The same cycle of operations is repeated during the period exposures are being made.

The second half of the camera is precisely the same in construction and operation as the first half. There is one important difference in the disposition of the color filter band in regard to its exposure, relatively to that in the other half of the camera. A blue instead of a red screen passes before the second lens aperture synchronously with that before the first lens. The effect is that in the course of the exposures there is a continual cutting off of the respective colors. That is to say, when red is exposed for the first lens, it is immediately succeeded by the blue in the second lens, followed in turn by green in the first lens, the latter then being cut off by the red in the second lens, then blue in the first, succeeded by green in the second lens, and so on. The accompanying diagram will best illustrate how the successive cutting off of the colors is effected.

Another notable point is that the inventor does not require three separate negatives taken through the red, green, and blue color filters respectively and then similarly superimposing their transparencies through relative color filters to secure the three-color effect. Such is the process generally followed in accordance with the Ives system of still-life color photography. By this last named process the film would obviously have to be three times the length of the monochrome record, in order to secure the three fundamental negatives, and would need to be projected at three times the speed to secure the desired effect. Mr. Friese-Greene, however, has ascertained that in chromo-photography such a process is unnecessary when carried out upon his lines and that the continual cutting in and out of the colors will enable them to be blended so easily and rapidly that the brain sees the heliochromic image only.

It will be realized from a study of the shutter arrangements in the accompanying illustration that each lens is insured an equal period of exposure. The shutter area is exactly one-half of that of a complete circle, and as one lens aperture is being cut off the other is being cut in, which materially assists in the blending of the colors, through their respective filters, there being an entire absence, from the eye point of view, of any sharp line of demarcation. The sighting and focusing of the camera follow the usual practice in such cinematographic apparatus, as does also the method of operation for taking photographs, though certain improvements have been incorporated. The camera itself is practically the same size as that of the single-lens instrument, everything being rendered as compact as possible.

The projector follows the lines of the ordinary instrument for this purpose, with the exception that there are two lenses placed side by side. Here again the exposure is intermittent. The two lenses are each fitted with a micrometer screw so that their angle to one another can be adjusted to a nicety and varied according to the size of picture projected, which of course is relative to the distance of the screen from the projector. The facilities whereby the angle of the lenses to one another is adjusted insures that irrespective of the size of the image exact superimposition of the two pictures projected from the twin lenses is absolutely certain upon the same given area.

In the projector two similar endless color filter bands have to be used. Their arrangement is very similar to that adopted in the camera, and suitable devices are employed for keeping them in absolute register with the picture film. It is quite impossible, therefore, for any difference in register upon the screen or confusion of color filter and its relative picture to result. Moreover, there is the same relationship in regard to the cutting in and out of the respective color filters to secure the desired blending of the colors, so as to insure in conformity with the phenomenon of visual persistence the impression of a perfect three-color image being conveyed to the brain. This result is also assisted by the fact that projection is really carried out at twice the usual speed, thirty-two pictures being thrown on the screen in the course of a second from the two lenses—sixteen from each. Owing to the perfect superimposition of the pictures from the

(*Continued on page 270.*)

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two lenses upon the white wall, remarkable clearness and definition are obtained, the color beauty of the image being appreciably enhanced by the stereoscopic effect which is produced. As also the two pictures depict continuous motion there is an entire absence of flickering due to the shutter, the effect being practically the same as if one were resorting to the camera obscura.

In order to secure the requisite stereoscopic effect in projection the apparatus for this purpose has necessarily to be of special design. Its general characteristics are plainly shown in the accompanying photographs (Figs. 4 and 5). There is the lantern body for carrying two illuminants, one for each lens. The lenses themselves are rendered angularly adjustable by means of a micrometer screw so that in stereoscopic work the two images may be exactly superimposed upon the screen and yet at the same time rendering it feasible to use the apparatus for ordinary work by cutting one-half of the lantern out of service.

The operating mechanism while broadly following that of the ordinary single projector is simpler. The feed spools are carried on a common axle at the top and the films lead down to their respective lines of travel through the gateway behind each lens, subsequently being wound up on the lower spools, these working synchronously through a central spring pulley drive.

Color projection can be effected either by a revolving disk carrying three equal-sized sectors of red, green, and blue glass, respectively, the cutting in and out of each color being precisely the same as in the camera. That is to say, while one lens is being uncovered the other is being closed, so that in reality the image from one lens is being thrown on the screen at one time instead of the two exposures being made simultaneously as in ordinary stereoscopic practice. It is the speed with which projection is made and the cutting in and out of the colors on each lens—about 25 per second—that in accordance with the peculiar law of visual persistence yields not only the natural color but also the stereoscopic effects.

Though the rotating disk is the simplest means of projection, the color effects are not technically correct nor so beautiful as are produced by the endless traveling band, composed of small color screens red, green, and blue, successively. This is attributable to two factors. In the first place, as the rotating disk is placed in front of the lens there is a certain distance through which uncolored light travels—that is, between the film and the color screen—and in projection there is a tendency toward jumbling of the three colors into the white light. On the other hand, when the color screen is in immediate juxtaposition with the film no white light whatever is projected.

The apparatus shown in the accompanying illustrations is applicable to either disk or endless band operation. If the band is used it is only necessary to withdraw the colored screen sectors from the revolving shutter, which is readily effected by means of clips which hold the screens in position, the three remaining opaque sectors acting as the cut-off between each successive color filter and its picture on the band. The band itself is carried over a jockey pulley and sprocket drum at the top of the projecting mechanism and carried down through the gateway with the transparent film against which it is tightly held during the instant of projection. Issuing from the gateway it passes over a lower sprocket drum and jockey pulley, where it leaves the picture film, which is wound on the spool below, the color band passing over a rigid horizontal arm shown in the illustration set at an angle of about 45 deg., so that the upward traveling part may clear the field of the lens, passing over another similar angular arm at the top which deviates it

(Concluded on page 271.)

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once more over the top sprocket drum and pulley where it meets the picture film traveling from the upper spool, and the operation is repeated.

The grave disadvantage of the revolving disk is that the screens therewith have to be, as it were, standardized; that is to say, must be such that they are equally applicable to any picture that may be used in projection irrespective of the densities of the color filters used in photographing. This often destroys or depreciates the true color effects and values. On the other hand, with the band it is possible to secure the same relative color screens that were used in taking the picture, so that the latter is virtually projected through the same color filters as were employed for photographing.

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THE VISITING WARSHIPS—A COMPARISON.

(*Continued from page 262.*)

point of bearing is most advantageous for her batteries and least advantageous for those of the enemy.

Now, from what we have said above, it will be evident that when an all-big-gun ship meets one that carries a mixed armament of big guns and guns of medium caliber, she will endeavor to place herself at sufficient distance from the enemy to be outside of the armor-piercing range of its medium-caliber guns and within the armor-piercing range of her own big guns. She can only do this, however, by possessing a reasonable superiority of speed, and the greater her excess of speed the more completely will she be master of the position.

Applying these facts to the "Connecticut," "Justice," and "Inflexible," we can see at once how completely the all-big-gun, high-speed, fighting ship of to-day outclasses the big and medium gun, moderate-speed battleship of the pre-"Dreadnought" period. The big-gun ship is *vitally* vulnerable only by the penetration of her waterline or of the barbettes and turrets in which the 12-inch guns are mounted. The greater part of the personnel of the pre-"Dreadnought" battleship, on the other hand, is stationed at the numerous guns of the secondary battery, where they are protected by comparatively light armor; and even at the fighting range of five miles they would be exposed to complete destruction by the high-explosive, 12-inch shells.

GUN POWER.—Comparing the three ships on the basis of gun power, we find that the "Connecticut" carries four 12-inch 45-caliber guns, eight 8-inch 45-caliber guns, and twelve 7-inch 50-caliber guns; the "Justice" mounts four 12-inch 50-caliber guns and ten 7.6-inch 45-caliber pieces; while the British "Inflexible" mounts eight 12-inch 45-caliber guns, but no secondary armament. Now, at a fighting range of five miles, the 12-inch gun of the "Connecticut," firing an 850-pound shell at 2,700 feet per second velocity, can penetrate 8 inches of Krupp armor; the 12-inch gun of the "Justice," firing a 731-pound shell with a muzzle velocity of 3,000 feet per second, can penetrate 7 inches of Krupp armor; and the 12-inch gun of the "Inflexible," firing an 850-pound shell at 2,900 feet per second, at the same range can penetrate 9 inches. Now, since the belt armor of the "Connecticut" varies from 11 inches amidship to 4 inches at the ends, and that of the "Justice" varies from 11 inches to 5½ inches at the ends, it follows that the vitals of both these ships would be quite secure against the attack of the "Inflexible" at this range; although it would be possible for her to penetrate both ships at each end of the waterline. Since the 12-inch guns of both the "Connecticut" and the "Justice" are protected by from 10 to 12½ inches of steel, they should be practically safe against penetration. On the other hand, the "Inflexible" would not fare so well, since her belt protection varies from 7 inches amidships to 4 inches at the ends, and she would be theoretically penetrable by the guns of both her opponents at five miles range. Her 12-inch guns, however, with a turret and barbette protection of 10 inches armor, would be secure against penetration.

It should be borne in mind, however, that these figures of penetration are worked out for impact *at right angles to the armor*. At these distant ranges the projectiles would be falling at an angle of several degrees, and therefore the resisting power of the armor on all three ships would be considerably higher than that mentioned above.

The secondary armament, both of the "Connecticut" and the "Justice," could riddle the unarmored, but could not penetrate the armored portions of the "Inflexible," whereas the turrets and casements in which this secondary armament is mounted could be completely destroyed by the "Inflexible's" guns. Thus, for the 8-inch of the "Connecticut" to penetrate the 7-inch belt of the "Inflexible," they would have to be within 5,400 yards of that ship, and the 7-inch battery would have to be within 4,000 yards; while the 7.6-inch gun of the "Justice" would have to be within 5,000 yards to effect penetration at normal impact. On the other hand, the 6-inch and 7-inch armor which protects the secondary battery of the "Connecticut," and the 5½-inch and 4-inch armor on the turrets and bases of the secondary battery of the French ship, would be at the mercy of the "Inflexible's" 12-inch guns.

In this supposititious engagement to show the advantages of the "Dreadnought" type of battleship over the type with the mixed armament, the "Inflexible" with an advantage of 6 to 8 knots of trial speed (it will be understood, of course, that an engagement would never be fought at these maximum speeds) would elect to place herself at the maximum effective range for her own guns, which, if the weather were clear, would probably be not less than five miles. Her higher speed would give her the same advantage which the "weather gage," or windward position, gave to the old fighting frigates in the days of sail power and the smoothbore. Her probable plan of attack would be to assume a position somewhat ahead of the leading ship and then concentrate the whole of her eight guns upon that vessel, in the endeavor to cripple each ship in detail; and it is an interesting question whether this concentration of fire on each ship in turn, coupled with the vulnerability of the armored positions of the secondary batteries, and the great exposure of the crews of those batteries, would not go far to offset the lighter armor protection of the "Inflexible." By taking skillful advantage of her superior speed, and if the gunnery on all three ships were equal, it is conceivable that she might win the fight. Should she be getting the worst of it, on the other hand, her higher speed would leave her free to draw out of the conflict, whenever her commander saw fit. From what we have said, however, it is evident that ship for ship she would be more than a match for either vessel alone, and in a duel she would probably close in to 6,000 or 7,000 yards, and try to overwhelm the enemy quickly with her 12-inch guns.

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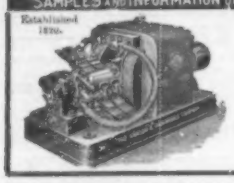

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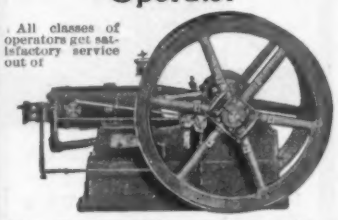

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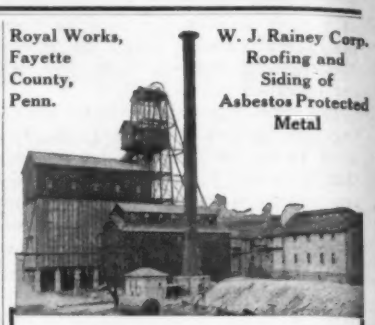

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